American Gas Journal

NINETY-NINTH YEAR

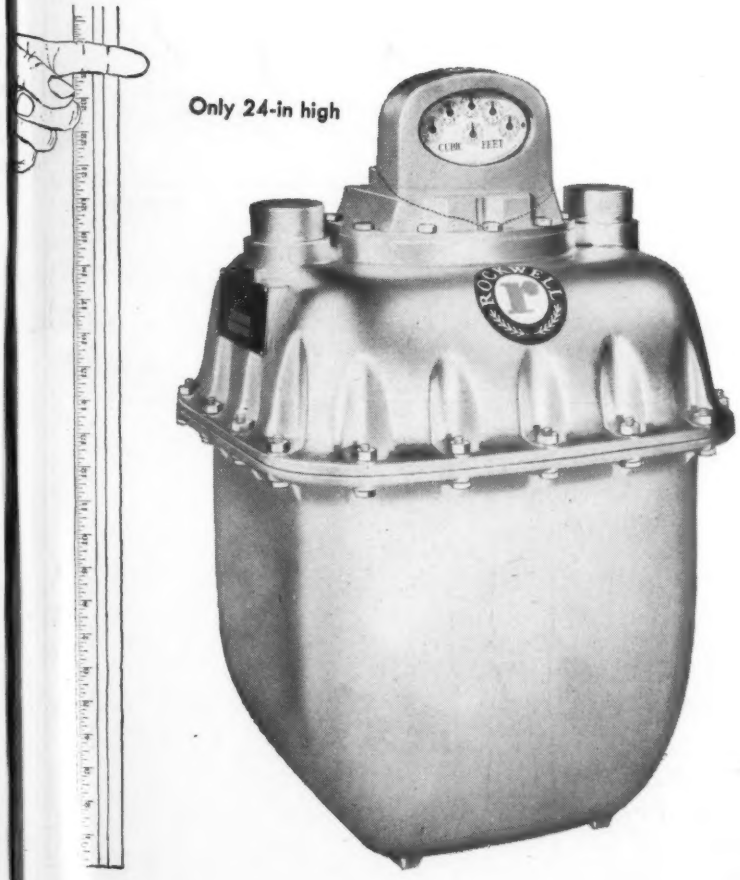
JUNE, 1958 | Only Magazine Edited Exclusively for the Gas Distribution Industry

OHIO STATE UNIVERSITY
JUN 10 1958
LIBRARY

You asked for it!

NEW ROCKWELL "750" *Aluminum* METER

For low pressure services such as restaurants, shopping centers, motels and schools.



BIG—750 cfh* capacity

LITTLE—47 lb weight

COMPACT

—16⅛" x 13¾" x 24" dimensions

(*Capacity rated at ½" diff. of 0.60 sp.gr. gas)

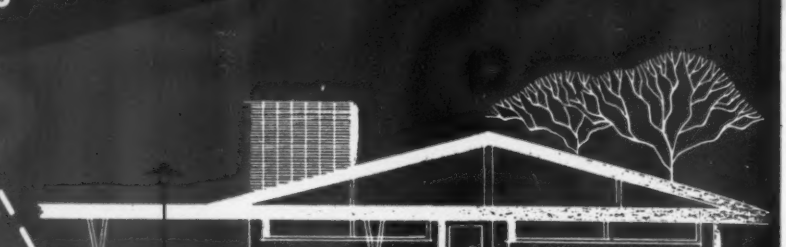
With the new "750", Rockwell answers your needs for a strong, safe, lightweight aluminum meter to handle a multitude of commercial services. Weighing only 47 lbs, it's easy to handle and install. The sturdy aluminum alloy case has high resistance to impact and weathering. Single joint construction simplifies repairs, reduces leakage risks. The Rockwell "750" is ideal for exposed settings and as a replacement for 30-light tin meters. Write for bulletin. Rockwell Manufacturing Co., Pittsburgh 8, Pa.

ALUMINUM GAS METERS

another fine product by

ROCKWELL

IN THE MODERN HOME



one GAS unit does it all

COOLS OR HEATS
DEHUMIDIFIES
CIRCULATES
VENTILATES
FILTERS

ARKLA-Servel
SUN VALLEY
ALL-YEAR AIR CONDITIONING

Investigate the many advantages of the SUN VALLEY *All-Year® GAS Air Conditioner for residential as well as commercial and industrial cooling and heating.

- Low OPERATING Cost
- Low MAINTENANCE Cost
- LONG-LIFE . . . with no moving parts
- Small, COMPACT units

3½ and 5-ton models . . . For either natural gas or LPG operation. 25-ton chillers for larger cooling tasks.

add traditional charm with Gaslite

*TRADE MARK

Manufactured by Arkla Air Conditioning Corporation, Evansville, Indiana

Established 1859

American Gas Journal ®

ONLY MAGAZINE EDITED EXCLUSIVELY FOR THE GAS DISTRIBUTION INDUSTRY

June, 1958 Vol. 185, No. 6

CONTENTS

MANAGEMENT & OPERATIONS

Gas Air Conditioning Roundup:
Economic Implications of Gas Air Conditioning 13
Scott Hughes

Arkla-Servel Year-Round Units Replace 17 Heat Pumps That Wouldn't Pump Heat 18
E. F. Davis

Research: Key to the Future of Gas Air Conditioning 21
Robert B. Smith

Current Considerations in Peak Shaving Economics 25
M. F. Hall

Operating Experiences with the Titrilog 29
S. W. Greenwood

American Gas Fundamentals:
Estimating General Service Revenues 32
Donald C. Neill

Substitutability of Propane-Enriched Carrier Gases for Natural Gas . 35
(Important—See page 59 for Errata in this article)
R. T. Ellington, E. F. Searight, and H. R. Linden

How to Compliment Your Employees
Another in the series helping you "Toward Better Management" 43
H. E. Carroll

CORROSION

Corrosion Notebook:
Cathodic Protection Difficulties Involved in Iron-Bound Compression Couplers in Gas Distribution Systems 23
John Emery

CONSTRUCTION

Distribution Developments:
News about current and planned construction 45

LOAD BUILDING

The All-Gas "Multimatic Wall"
"Amazing new appliance center from AGA research designed to build a house around" 52

FEATURES

Fuel for Thought 3
MCF—News Hilites 7
Coming Events in the Gas Distribution Industry 10
Corrosion Notebook 23
American Gas Fundamentals 32
Toward Better Management 43
Distribution Developments 45
News About the Gas Distribution Industry 56
Men at Work 58
Bulletin Board 60
Product Previews 61
Advertisers' Index 64

AMERICAN GAS JOURNAL is a registered trademark. Entire contents of this issue copyrighted. Reproduction of any part without permission of copyright owner is strictly prohibited.

THIS BUTTON COULD BE MILES AWAY

The push button on the automatic gas distribution valve above could be as shown . . . or hundreds of miles away. For remote operation, gas men must have the most dependable valves available . . . valves they know will work every time. Here's why they specify Rockwell-Nordstrom valves on these services.

Dependable operation is assured in Rockwell-Nordstrom valves by the lubricant that keeps the plug free for instant, quarter-turn operation.

Leak-proof service. Even on high pressure gas lines, Rockwell-Nordstrom valves stay leak-proof because pressurized lubricant forms a bottle-tight seal against gas leakage at both valve ports.

Rockwell-Nordstrom is the world's most complete line of lubricated plug valves, lubricants and accessories. Available with electric, hydraulic or pneumatic cylinder operators to answer every power operated valve need. For details, write: Rockwell Manufacturing Company, Pittsburgh 8, Pa. Canadian Valve Licensee: Peacock Brothers Limited.

ROCKWELL-Nordstrom VALVES

it's **ROCKWELL**

MANUFACTURING COMPANY

American Gas Journal

Established July 1, 1859

•

Dean Hale
Editor
Pat Baar
Assistant Editor
Ernestine Adams
Economics and Management Editor
Donald M. Taylor
Gulf Coast Editor, JAckson 6-2631
2370 Rice Blvd., Room 110, Houston, Texas
Jan Craig
Editorial Production Manager
Donald D. Fickert
Presentation Editor
Lynn Patton
Editorial Assistant
Cecile Pincus
Editorial Assistant
Leo T. Parker
Contributing Editor

•

Joe B. Woods
President and Publisher
Abbott Sparks
Vice President and Advertising Director
Frank H. Love
Vice President
L. H. Johnston
Secretary-Treasurer

•

Allen K. Tyler
Advertising Service Manager
Production Manager
Charles McKean
Circulation Director
Royal Courtney
Circulation Fulfillment Manager
Sherwood R. Entwistle
Circulation Promotion Manager
Nella Gibson
Assistant Production Manager

•

NEW YORK: John Wallace, Clyde Dillehay
52 Vanderbilt Ave., MUrray Hill 6-7232
CHICAGO: E. V. Perkins, John McDonald
53 West Jackson Blvd., HArrison 7-6883
LOS ANGELES: Richard P. McKay
465 East Union, Pasadena, RYan 1-0685
PITTSBURGH: Art G. Gilliam
4525 McKnight Rd., WEllington 1-0619
BIRMINGHAM: Fred W. Smith
1201 Forest View Lane, Vesthaven, TRemont 1-5762
HOUSTON: Jess Adkins
2370 Rice Blvd., Room 110, JAckson 6-2631
DALLAS: Ed Sealey
800 Davis Bldg., Riverside 8-4403

Cable Address: PEPUB

Member Audit Bureau of Circulation and Associated Business Publications. Copyright, 1958, The Petroleum Engineer Publishing Co., Dallas, Texas. Subscription Rates: U. S. and Canada $3.00 per year; $5.00 two years. South American and Foreign $5.00 per year; $10.00 two years. Single copies, $1.00 except September 15 Handbook issue not sold separately.

Printed in U.S.A.

Fuel for Thought

TWO DECADES AGO, the lyrics of a popular song declared "round and round she goes, and where she stops, nobody knows."

Apparently, this same tune is a theme song of the federal government today. For round and round federal bureaucrats are going, and where they'll stop before they are through with the gas industry, nobody knows.

Latest in a long series of incidents involving governmental intervention in the operations of the gas industry is the filing of anti-trust law violation charges against three major gas companies and their top officials.

Named as defendants in a four-count criminal indictment returned by a federal grand jury in Milwaukee are American Natural Gas Company, Northern Natural Gas Company, Peoples Gas Light and Coke Company, and the chief executive officers of the three companies.

First of its kind, the case finds the Department of Justice attempting to extend anti-trust laws to matters within the jurisdiction of the Federal Power Commission. Anti-trust officials are attaching major significance to the case, which they describe as the first in which natural gas companies have been charged with conspiring to eliminate competition.

> *Strange, then, is it not, that one hand of the government says that gas companies are competitive and subject to anti-trust laws while another hand, extended from judicial black robes, says that gas companies are not competitive, that they are public utilities, and therefore must be regulated because they are monopolistic in nature?*

The indictment stems from charges made last autumn by Governor Vernon Thomson of Wisconsin that the three gas firms "acted collusively" to prevent Midwestern Gas Transmission Company from building a 2067-mile pipeline system to bring gas into the upper Midwest area from both Canada and the Southwest. Midwestern's plan has been before the FPC since October, 1955 *(see page 20,* AMERICAN GAS JOURNAL, *November, 1955)* and has been opposed by the three indicted firms, who have produced plans of their own to supply the area.

This anti-trust indictment alleges that, beginning in 1954, the defendants conspired to monopolize the interstate transmission and sale of natural gas in Wisconsin, Minnesota, and parts of Illinois and Michigan. It further alleges that the four companies, through conspiracy, had prevented consumers in these four states from obtaining natural gas over the past several years.

Apparently, the anti-trusters never bothered to inquire as to how long a period of time might be required by the Federal Power Commission in its procedure to decide a case with so many controversial issues such as the one in question.

The authority to decide what pipeline system or systems will serve the area in question, the manner of service, rates charged, and volumes of gas to be delivered rests solely with the FPC, as outlined in the Natural Gas Act of 1938. That agency has complete jurisdiction and responsibility.

Victor R. Hansen, federal anti-trust chief, is reported to have declared, with regard to the case in mention, that "the indictment seeks to insure that private groups cannot — without bringing on criminal proceedings — conspire to deprive any section of this country of needed fuel supply."

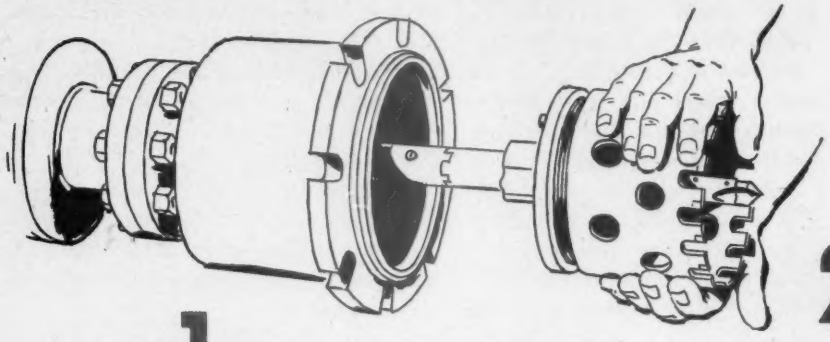
As far as we can determine, such has not been the case. In following established procedure, the companies involved in this case have presented their sides to the proper authority – the Federal Power Commission. Whatever delay has been incurred thus far has been the product of following established procedures. Do the anti-trusters plan to also indict the FPC and the Natural Gas Act?

By their actions, the anti-trusters have served no really useful purpose — except to further delay the ultimate solution to the question at hand: *When will the upper midwest area get more gas?*

—The Editors

AMERICAN GAS JOURNAL, June 1958, Vol. 185, No. 6. Published monthly (except September, then semi-monthly) by The Petroleum Engineer Publishing Company, P. O. Box 1589, Dallas 21, Texas. Second class mail privileges authorized at Dallas, Texas. Executive and Editorial Offices at 800 Davis Building, P. O. Box 1589, Dallas 21, Texas.

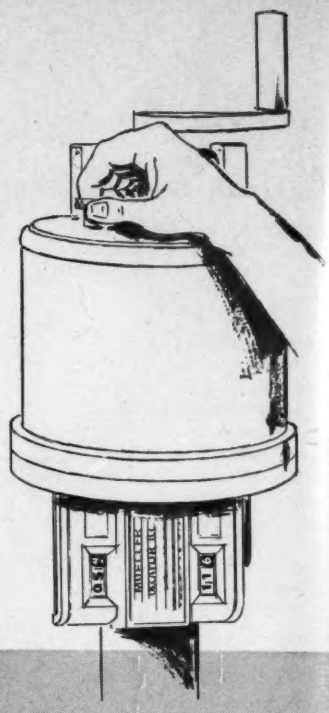
here's how to make a 6" cut with the "CH-6"...



1

attach cutter

Bolt adapter to drilling machine and advance boring bar with rapid feed hand crank. Lock boring bar with front lifting yoke. Remove retaining screw and insert shaft of cutter arbor into socket of boring bar. Replace screw in shaft and tighten with screwdriver. Screw pilot drill into cutter arbor and tighten. Screw shell cutter onto arbor and tighten. Retract boring bar and bolt machine to gate valve.



2

set feed travel indicator

Advance boring bar with rapid feed hand crank until pilot drill almost contacts main. (Full-time tool position indicator eliminates tool position guesswork.) Test entire set-up for pressure tightness. Set the amount of cut required by turning the "auto feed set" knob until the exact amount appears on the "feed travel indicator". (Large, easy-to-read numerals show the amount of cut in inches and tenths of an inch.) Engage automatic feed and feed travel indicator.

Save time on cuts up to 6"

use the new Mueller® CH-6 drilling machine

Now—Mueller Co. has developed a fast, automatic drilling machine for making cuts from 2" through 6" under pressures up to 1440 p.s.i.

The new "CH-6" Machine may be hand operated with a ratchet handle or power operated with the Mueller H-601 Air Motor or H-602 Gasoline Engine Drive Unit. *No changes in the machine are needed to use either method of operation.*

(In tests, under ideal conditions, the cutting speed of a power-operated CH-6 was found to be twice as fast as older machines.)

New features also reduce set-up time. Automatic power cutting completely frees the operator of continual check on the machine during cutting operation. Total on-the-job time is drastically cut!

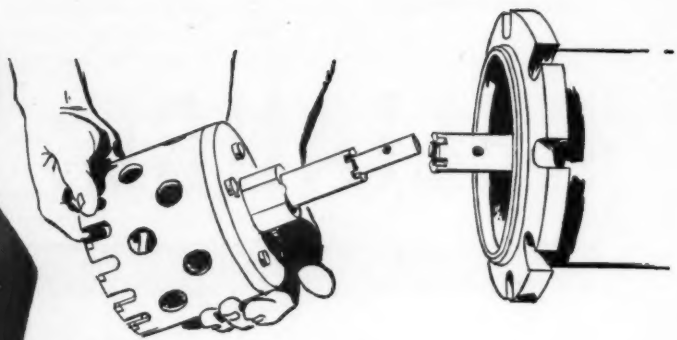
See your Mueller Representative or write direct for the full "time-saving" story of the new "CH-6" Machine.

NO-BLO®

3

make cut

Loosen pivot thumb screw and remove pivot pin. Remove front lifting yoke. Position air motor holder and replace pivot pin. Tighten thumb screw. Swing latch bolt into position and tighten wing-nut to secure holder. Slip H-601 Air Motor into holder. Open throttle slightly to align and engage spindles. Screw air motor retaining bolts into place and tighten. Open air motor throttle and set at proper operating speed. The "CH-6" will now make the cut automatically without supervision. When the cut is completed, the feed is automatically disengaged to prevent damage and loss of time. Overtravel of the boring bar is positively prevented.



4

remove machine and cutter

Check completion of cut by advancing cutter with hand feed crank. If cutter does not advance readily, further cutting is needed. If cut is completed, retract cutter with rapid feed hand crank and close valve. Remove air motor and holder and replace front lifting yoke. Remove machine. Advance boring bar and lock with front lifting yoke. Unscrew arbor retaining screw and remove cut-out section of pipe, shell cutter, cutter arbor and pilot drill as a unit.

MUELLER CO. since 1857 SERVING the Water and Gas Industries QUALITY

MUELLER CO.
DECATUR, ILL.

Factories at: Decatur, Chattanooga, Los Angeles, In Canada. Mueller, Limited, Sarnia, Ontario

The name RELIANCE that identifies every regulator is more than our trademark.

To you, it is your assurance of advanced design, safety and rugged construction for dependability and long service life.

The name RELIANCE also represents over 45 years of progress in serving the Gas Industry . . . a challenge to continue building our products to the highest standards of quality and performance.

RELIANCE: symbol of reliability to the gas industry

HPH

CBV—DIRECT

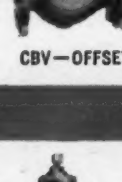
DV-RV

CBV—OFFSET

HPC

H-K

1400



HPR

MAKE GAS BEHAVE WITH RELIANCE—THE MOST ECONOMICAL IN TERMS OF SERVICE!

WRITE FOR BULLETINS CONTAINING COMPLETE SPECIFICATIONS

AMERICAN METER COMPANY
INCORPORATED (ESTABLISHED 1836)

AMERICAN METER CO

RELIANCE REGULATOR DIVISION
ALHAMBRA, CALIFORNIA

Mcf

Russian gas men have developed a new liquefied natural gas storage plant in Moscow that, according to Red sources, will accommodate 2,000,000 cubic meters (approximately 70,600 Mcf) of liquefied gas, enough to take care of seasonal variations in demand. The Moscow region reportedly depends on natural gas for 30 percent of its fuel requirements. The installation, as reported in the *International Energy Reports of United Nations Developments,* a New York-published bulletin on world-wide energy developments, first purifies and dries natural gas, then liquefies it by refrigeration, from where it is stored and finally regasified as needed.

Homes heated with gas increased by 1,194,000 in 1957, reports the AGA. The 7.1 percent rise brought the number of gas-heated dwellings to 17,900,000, constituting 62.5 percent of all residential consumers. During the next three years, another 3,600,000 new heating customers will be added, the result of new construction and modernization of existing homes. The survey did not include homes served with LPG or apartment houses and similar buildings with central heating systems. As of November 30, 1957, there were 55 gas utilities that still had some restrictions on new home installations of gas heating. In 1956, there were 58 gas utilities.

Ontario Research Foundation has been appointed to undertake a study of gas distribution systems throughout the province of Ontario, upon the recommendation of the Ontario Fuel Board. According to J. W. Spooner, Minister of Mines, the introduction of large volumes of natural gas to Ontario and the resultant gas industry expansion make it advisable to conduct a general study of engineering practices, materials, maintenance, inspection procedures, and safety measures being used by gas distribution companies.

Illinois Governor William G. Stratton has urged that federal and state governments permit the oil and gas industry to operate free of controls wherever and whenever possible. Stratton emphasized that only by restoring the gas industry to what he termed its historically independent status could the public interest be served. He noted that if the trend toward federal power were to be resisted, certain functions that "rightfully belong to the states" must be returned to them.

Reimbursement of public and private utilities for relocation costs incurred by the federal-aid highway construction program, provided for in a 1957 Texas law, has been challenged by Texas' State Attorney General Will Wilson in suits filed against the cities of Dallas and Austin and four utility companies, including Lone Star Gas Company. The Texas State Highway Department told the two cities and the four private utilities to relocate, at their own expense, utility installations on interstate highway roads. They refused, countering with a demand for reimbursement, which the highway department refused. Wilson held that the law violates a section of the Texas Constitution prohibiting donations of public money to any corporation or individual.

Construction is underway at Lebanon, Ohio, by Texas Eastern Transmission Corporation on an underground storage facility for LPG to be carried by TETCO's Little Big Inch products pipeline. A cavern capable of holding about 12,000,000 gal of LPG is being carved out of gray shale 350 ft underground. Ultimate capacity will be about nine times this amount. The LPG is to be transported in liquid form from southeast Texas to the site.

Cooperative campaign to help builders sell all-gas homes has been initiated in the tri-state area around Pittsburgh by five gas companies — Equitable Gas, Manufacturers Light and Heat, Peoples Natural Gas, East Ohio Gas, and Hope Natural Gas. The campaign was kicked off by seven meetings in the Ohio-Pennsylvania-West Virginia area for builders, with 3700 attending. Theme of the campaign is that a home owner can save a total of $9996 in 20 years by choosing an all-gas home, based on a comparison of local gas and electric rates and monthly fuel requirements.

Navy research may make it possible for gas utilities someday to sell homeowners their own, individual, gas-fired "electric plants." The Navy has reported that its scientists are close to solving the riddle of efficiently turning heat directly into electricity. Far-sighted gas-industry observers foresee the day when every home could produce its own electricity from a gas-fired direct-heat-to-electricity generator.

Is six percent enough "fair return" on utility investments? Hardly, says Basil B. Elmer Jr., assistant vice president of the First Boston Corporation, who told 1000 delegates to the National Conference of Electric and Gas Utility Accountants that a 6 percent return "no longer can be considered satisfactory." Elmer told the group, meeting in Houston, Texas, that a higher rate is essential to assure future financing of utility expansion. He suggested that, under present conditions, an increase to 7 or 7½ percent should be permitted by regulatory bodies so that utilities could compete for investor funds. He estimated that the gas industry alone must raise about $32-billion through the sale of stocks in the next 12 years to keep up with increasing demands for gas service.

Gulf Interstate Gas Company will be acquired by The Columbia Gas System, Inc., pending approval by stockholders of Gulf Interstate and the consent or approval by government agencies and regulatory bodies. Gulf Interstate owns and operates an 860-mile, 30-in. gas transmission line from Louisiana to West Virginia, plus 350 miles of lateral and gathering lines in Louisiana. The pipeline has 10 compressor stations of 14,000-hp each, 5 of them automatically operated by remote control. The acquisition does not include a wholly-owned subsidiary, Gulf Interstate Company, primarily an engineering consulting firm, which would be sold or otherwise distributed to present Gulf Interstate stockholders. The Gulf Interstate Company, which will be retained to render engineering services to Columbia and its subsidiaries, has a contract to engineer and design facilities of the Transwestern Pipe Line Company from West Texas to California.

out front on ODORIZATION service!

Oronite ODOROMETER

The unique Odorometer — the simplest means of testing the odor character and intensity in a distribution system — is another example of Oronite service to the gas industry.

With the Odorometer, the odor characteristics of a gas stream can be determined at any convenient point on the gas distribution or transmission lines. It is both a more accurate and a much faster method of determining odor levels than the previously used "room-test" method. By making periodic checks with the Odorometer, gas utilities are maintaining odorant intensities at a safe and constant level.

For complete information on the Oronite Odorometer — facts about its construction and principles, operating instructions — contact the Oronite office nearest you. Or, ask for a demonstration of the Odorometer on your system.

Oronite Gas Odorant Products

Calodorant® C — completely stable cyclic sulfide-type odorant
Calodorant® C Special — blend of Calodorant C and solvent
Calodorant® B-1 — a sulfide odorant at a mercaptan price
Alert® 80 — best economy-priced, quality mercaptan odorant
Ethyl Mercaptan — a high quality pure mercaptan for LP gas
LPG Odorant — tailor-made from a selected mercaptan cut

ORONITE CHEMICAL COMPANY

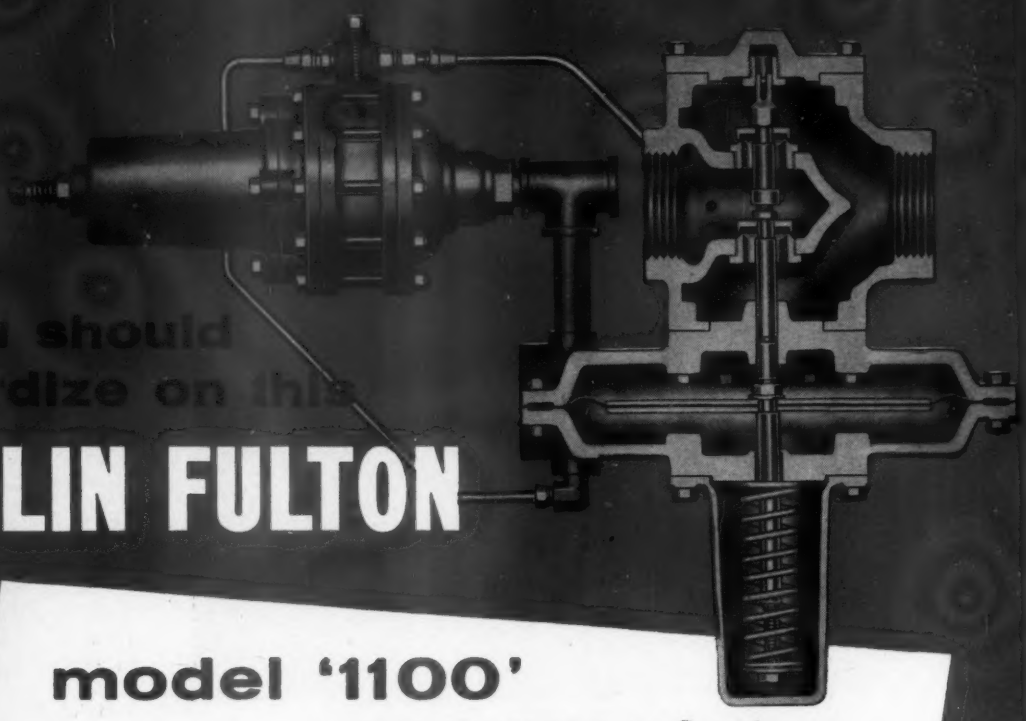
A CALIFORNIA CHEMICAL COMPANY SUBSIDIARY

EXECUTIVE OFFICES • 200 Bush Street, San Francisco 20, California
SALES OFFICES • New York, Boston, Wilmington, Chicago, Cincinnati, Cleveland, Houston, Tulsa, Los Angeles, San Francisco, Seattle
Foreign Affiliate: California Chemical International, Inc., San Francisco, Geneva, Panama

4957

you should
standardize on this

CHAPLIN FULTON



model '1100' gas regulator

Let's not beat around the well head, this Model "1100" is the most versatile gas regulator in the business. It gives a wider range of flow control in industrial, commercial or distribution installations. Just look at these points of superiority:

wider application
Inlet Max.—400 psi. Outlet Range 1" to 150 psi. Size—2" only, screwed, flanged 125 or 250 ASA

greater capacity
24,000 cfh at 10 psi to ounces; 114,000 at 100 psi. Body contoured for flow

easier maintenance
Regulator or pilot can each be serviced without disturbing the other. Easily accessible orifices in both, quickly renewable

simpler installation
Only one connection required. No complicated pins or toggles to adjust

the heart of model 1100

TYPE 51 VARIABLE PRESSURE PILOT

- Unitized construction—valve lever and orifice as a unit are removed from the outside, without disturbing balance of assembly. The likely trouble spot, the orifice, is outside where you can get at it quickly. No internal tubes to clog.
- Twin diaphragms remove as a unit
- Internal relief unit—guards against overpressure
- Spring unit—remove three screws to change springs
- Built for service
- Used for accuracy

Write for bulletin 1100

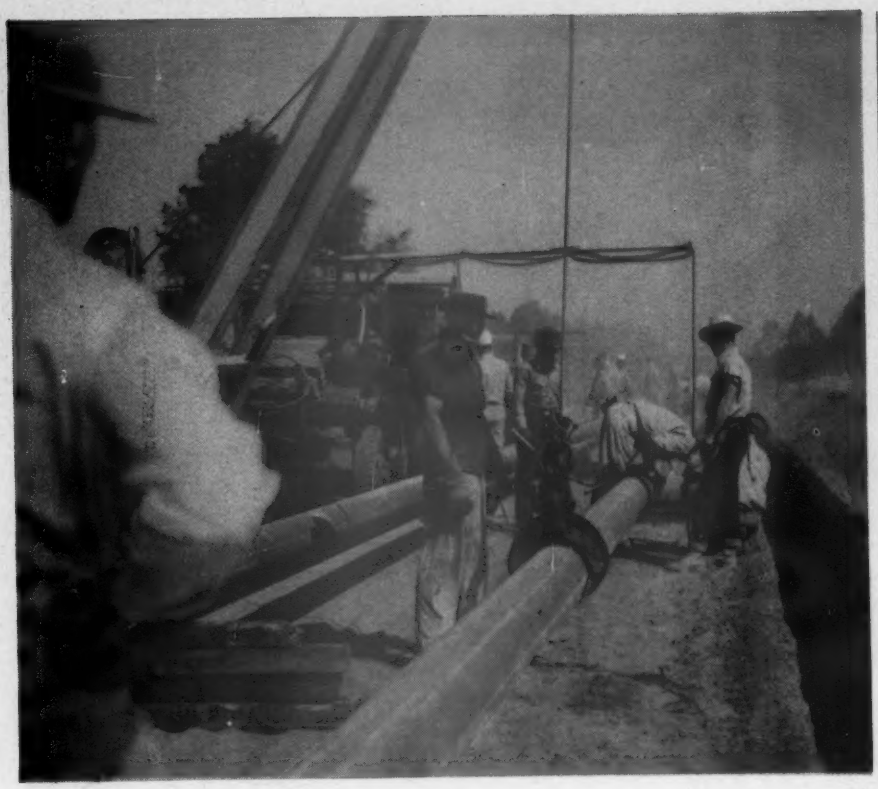
ACCURATE CP MFG CO DEPENDABLE

WSW-6836

Chaplin-Fulton

MANUFACTURING COMPANY

Pittsburgh 25, Pennsylvania



you can depend on Lone Star API pipe

...quality controlled for long, trouble-free service

Crossing rivers, bending over steep hills and rugged terrain is routine for Lone Star electric weld line pipe. Joe Roughneck, heart of the oil and gas industry, knows he can depend on Lone Star API casing, tubing and line pipe . . from the oil country's own steel plant. Fully normalized, of course.

Neighbor, wherever you are, specify Lone Star and we both get a good deal.

Lone Star STEEL COMPANY

EXECUTIVE—SALES OFFICES
W. Mockingbird Lane at Roper • P. O. Box 12226 • Dallas, Texas
DISTRICT SALES OFFICES
912 Republic National Bank Building, Dallas, Texas
Houston, Texas | Midland, Texas | Tulsa, Oklahoma

Coming Events

IN THE GAS DISTRIBUTION INDUSTRY

June

1- 4 Institute of Appliance Manufacturers, annual convention and exhibit, Netherland Hilton Hotel, Cincinnati, Ohio.

4- 5 AGA-PCGA joint domestic gas research and utilization conference, Ambassador Hotel, Los Angeles, California.

10-12 Appalachian Underground Short Course, West Virginia University, Morgantown, West Virginia.

11-13 NEGA, operating division, Sheraton Biltmore, Providence, Rhode Island.

15-19 American Society of Mechanical Engineers, Hotel Statler, Detroit, Michigan.

22-27 American Society for Testing Materials, annual meeting, Hotel Statler, Boston, Massachusetts.

23-24 Michigan Gas Association, Grand Hotel, Mackinac Island, Michigan.

24-27 Canadian Gas Association, annual meeting, Manoir Richelieu Hotel, Murray Bay, Quebec, Canada.

July

24-25 5th Annual Symposium on Computers and Data Processing, Albany Hotel, Denver, Colorado.

August

25-27 Appalachian Gas Measurement Short Course, University of West Virginia, Morgantown, West Virginia.

September

3- 5 PCGA annual convention, Benson and Multnomah Hotels, Portland, Oregon.

5 New Jersey Gas Association, annual meeting, Berkeley Carteret Hotel, Asbury Park, New Jersey.

12 NEGA commercial industrial heating division, Wachusett Country Club, West Boylston, Massachusetts.

17-19 Southeastern Gas Association, annual meeting, Sir Walter Hotel, Raleigh, North Carolina.

October

9-10 National Noise Abatement Symposium, Hotel Sherman, Chicago, Illinois.

13-15 AGA, annual convention, Atlantic City, New Jersey.

20-24 National Safety Council, Chicago, Illinois.

20-24 NACE, annual conference and exhibition, south central region, Roosevelt Hotel, New Orleans.

21-22 Purchasing Workshop Conference, Illinois Institute of Technology, Chicago, Illinois.

22-24 Air Conditioning & Refrigeration Wholesalers, annual meeting, Sheraton-Palace Hotel, San Francisco, California.

29-30 Computer Applications Symposium, sponsored by Armour Research Foundation, Morrison Hotel, Chicago, Illinois.

30 NEGA operating division, Sheraton Kimball Hotel, Springfield, Massachusetts.

November

18-20 American Standards Association, Hotel Roosevelt, New York, New York.

19-21 Mid-West Gas Association gas meter and service school and conference, Iowa State College, Ames, Iowa.

This PITT CHEM protected gas main is going underground for the rest of your life!

ONE of the most practical and economical steps you can take to insure against costly distribution line failure is to use the proven protection of quality *coal tar* coatings.

And when it comes to coal tar coatings, more and more gas companies are depending on PITT CHEM Enamels—protection that has been proven over the years on major transmission lines and distribution lines alike. No other material can do a better or more economical job of resisting soil stress and water absorption.

When you specify PITT CHEM Enamels for your distribution lines you're providing maximum protection for one of the biggest investments you make.

Call on us for the services of a PITT CHEM man to help you plan your next distribution line protection program. He's an experienced coating man, ready to give you or your mill coater valuable technical assistance.

★ **PITT CHEM Pipeline Enamels**
★ **PITT CHEM Coal Tar Coatings**
★ **PITT CHEM Insul-Mastic Coatings**

PROTECTIVE COATINGS DIVISION
PITTSBURGH COKE & CHEMICAL CO.
Grant Building • Pittsburgh 19, Pa.

WSW 7178

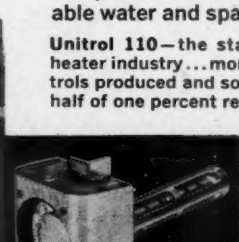
PROTECTIVE COATINGS • COAL CHEMICALS • PLASTICIZERS • ACTIVATED CARBON • COKE • CEMENT • PIG IRON

From its modern $10,000,000.00 plant in Long Beach...

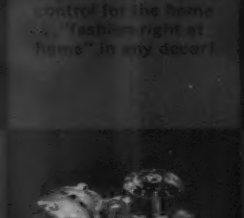
Robertshaw enters the manufacture of **Central Heating Controls!**

* **Exacting Quality Control**—a proved factor in the successful development and production of millions of dependable water and space heater controls.

Unitrol 110—the standard of the water heater industry... more than 3,000,000 controls produced and sold with less than one-half of one percent returns.



* **Exacting Quality Control**—now lends its technique to the manufacture of Central Heating Controls and Accessories!



Dependable Robertshaw controls are advertised nationally to your customers in Good Housekeeping, American Home, Sunset and Saturday Evening Post.

CONTACT:

Robertshaw-Fulton CONTROLS COMPANY

GRAYSON CONTROLS DIVISION, LONG BEACH, CALIFORNIA

A New Look at the "New Look"

Gas air conditioning, until just recently, was something like the weather . . . everybody in the gas industry was talking about it, but no one seemed to be doing anything. But times have changed, and just what is happening? What's being done to push gas air conditioning to the front as a summer load builder and a profit maker for the distribution companies (and the entire industry, for that matter)?

In this 10-page report, you'll find out why gas air conditioning is important in the competitive struggle between fuels; what AGA and leading manufacturers are doing to develop new and practical gas-fired air conditioning equipment; and how alert gas utility managers like Ed Davis and his sales force are selling Arkla-Servel units to the chagrin of the electric people.

This is just the beginning. In subsequent issues, AGJ will bring you more data on this fabulous new market for gas, how to sell it, and the equipment and how it works. We suggest that you clip and file this section for reference.

— The Editors.

In This Report . . .

1 — The Economic Implications of Gas Air Conditioning . . . 13

2 — In Chattanooga, Arkla-Servel Units Replace 17 Electric Heat Pumps 18

3 — Research: Key to the Future of Gas Air Conditioning 21

Economic Implications of Gas Air Conditioning

Scott Hughes
First Vice President
Southern Union Gas Company
Dallas, Texas

GAS AIR CONDITIONING, for quite some time, has been one of the favorite discussion topics within the gas industry generally received with interest and enthusiasm. It became increasingly apparent, however, that there was a conspicuous void of real economic data — that is to say, the net income type of information — concerning the potential impact of gas air conditioning in many of the gas service areas across the nation.

In 1957, AGA's committees on Economics and on Rates joined with the association's staff in creating a Task Force to ponder the economics of gas air conditioning.

At the outset of its deliberations, the Task Force had to establish a number of basic premises, or perhaps more accurately, initial points of departure.

First: It was clearly recognized that each gas company is operating in an economic world of its own to a large degree. Individually unique are important company items such as the cost of gas and the applicable formula; the existing gas market served and the load factor; a comparison of local gas and electric rates, and the relative incremental or replacement volumes of gas that might be sold for cooling purposes under local conditions.

Second: It was discovered that as yet there is no generally accepted climatic measure from which to predict with proved or economic accuracy the use of gas for comfort cooling. The familiar 0.225 therms of gas per heating degree day — which industry experience has widely adapted to local conditions — presently has no cooling counterpart, largely because of the greater impact of wet bulb temperatures in comfort cooling requirements. Of course, a useful cooling degree concept will be available in time. Of particular interest and promise are the studies of Earl C. Thom, meteorologist of the U.S. Weather Bureau, and his proposed "Discomfort Index" from which cool-

ing degree days may be directly calculated. It would seem to behoove interested gas companies to accumulate the requisite data required in the Thom formula and evaluate the results.

In this same connection, the U. S. Air Force has suggested a dry and wet bulb formula of its own. The Air Force formula has been spot checked against weather data for quite recent years and is unadjusted for longer range implications. Under these circumstances, the Air Force formula does suggest an energy use for comfort cooling substantially above that of other studies, including those of the Task Force. The Air Force formula would take the number of hours daily that the dry bulb reading exceeds 80 F plus twice the number of hours that the wet bulb reading exceeds 67 F, dividing this sum by six to give the number of hours of anticipated daily operation of the cooling equipment.

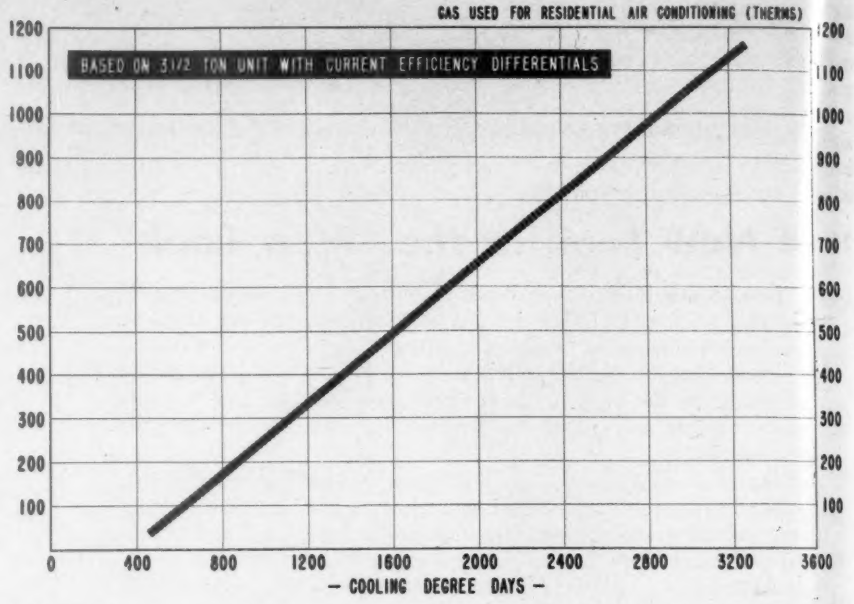


FIG. 2. Relation between seasonal cooling degree days and gas consumption for residential air conditioning.

Fig. 1.
Equation for Discomfort Index, and Derivation of Cooling Degree Days. Developed by Earl C. Thom, U. S. Weather Bureau.

$DI = [(Td+Tw)+2]+0.1[150-(Td+Tw)]$
which can be simplified to
$DI = 0.4\ (Td + Tw) + 15$
where
DI = Discomfort Index
Td = Dry bulb temperature
Tw = Wet bulb temperature

The excess of the average of the sums of the individual hourly Discomfort Index values secured from 24 pairs of hourly dry-bulb and wet-bulb temperatures over the base of 60 is proposed as the cooling degree-day value for the day.

Source: Air Conditioning, Heating and Ventilating; June 1957; P. 73ff.

The Task Force took yet another approach to the problem of estimating air conditioning use, which will be discussed in a moment. As best possible, the Task Force did attempt to normalize its results against the longer range temperature data.

Third: The Task Force accepted for its purposes the existing and excellent equipment which is available for gas air conditioning installations today. This does not mean that we are blind to the prospect of product improvement and/or lower equipment costs in future years; but the present gas equipment is, most surely, a present economic fact. For many of its calculations, the Task Force accepted as representative of the relative energy efficiency of gas and electricity, today's Arkla-Servel equipment: That is to say 4½ to 1. However, it did seem that realism should also consider the probability of a 3 to 1 ratio in the near future. Such efficiencies are presently available in some motor-driven gas air conditioning equipment.

Fourth: It seemed to the Task Force that the greatest need of the collective individual consumer, and therefore the most attractive market for gas air conditioning, is on a year-round basis, cooling in the summer — heating in the winter. For these, as well as for competitive reasons, we have related the two. Popular usage may have narrowed the term "air conditioning" to summer cooling, but the gas industry might do well to broaden the term to a concept of year-round human comfort. *The fact that an add-on unit of new design will soon be available — following extended field testing — for easy incorporation into existing gas-fired, central heating plants, can only add stimulus to the growing potential of gas air conditioning.*

Fifth (and final premise): The Task Force decided to separate the economic study of residential air conditioning from that of commercial air conditioning. No real statistical approach to the economics of commercial

Fig. 3.
Existing Monthly Load Factor,* and Load Factors with Varying Gas Air Conditioning Saturations.

City		Current Load Factor	Assuming Air Conditioning Saturations of 5%	10%	15%	25%
Gulf Coast						
	A	43	47	51	54	58
	B	30	35	38	40	45
South						
	C	31	33	35	37	39
	D	na	na	na	na	na
	E	17	19	21	23	27
	F	12	14	15	16	19
Midwest						
	G	18	21	22	24	28
	H	41	44	46	49	53
	I	16	18	20	21	25
East						
	J	21	24	27	30	35
	K†					
Mountain						
	L	15	16	16	17	17

*Ratio of firm sales in lowest month to firm sales in peak month.
†Omitted because of special circumstances which create unrealistic answers.

air conditioning by gas equipment could be developed at this time; but all indications pointed to a conclusion that gas air conditioning installations for commercial use, especially in the larger sizes, are today fully and favorably competitive in most areas with that offered by the electric service.

12-City Analysis Results

The generally acceptable case study approach was used, making sure that a number of different cities with widely varying climatic conditions were included. At this point, the AGA Bureau of Statistics undertook a principal chore.

A wide, cross section of individual gas companies were requested to supply their own estimates of the relativity of gas consumption as to heating and to cooling by a typical residential consumer in their service area. Naturally, this sort of estimation, however carefully done by the separate companies, produced a variety of results in the composite. Nevertheless, upon refinement and sound statistical extrapolation of these estimates, some reasonably consistent relationships and results were indicated.

Twelve cities scattered throughout the country were then selected for data purposes. Again, the results were carefully tested and normalized, by the only practical methods available, against longer range data on cooling degree days as well as against the so-called "Discomfort Index" of Mr. Thom where available. For those interested, the Bureau of Statistics will be glad to make the basic data and calculations available (Fig. 2).

The Task Group next considered, for the 12 test cities specifically, what impact could be made on load factor — a term with which most of us in the gas business are only too familiar — by the indicated therm consumption for residential air conditioning at various saturations. This is presented in Fig. 3.

While noting that the potential load factor improvement in these cities generally is from good to spectacular, depending upon the air conditioning saturation assumed, I should also stress another conclusion of the Task Force recorded as follows:

"It was felt that central gas air conditioning units will be designed to run at a constant hourly load factor in the summer, rather than to turn on and off as hourly temperature fluctuations require.

"Accordingly, the use of relatively substantial numbers of gas air conditioning units are not likely to create hourly peaks, and their saturation would have to be most substantial before daily summer peaks were created by residential users.

"Consequently, it will not be necessary, for the purposes of this analysis, to undertake research regarding the point in which the saturation of gas air conditioning load will require system expansion or strengthening, with a consequent necessary allocation of capital costs. This is a problem for the long term future, which subsequent analyses can explore."

Four charts present graphically the impact on the summer valley in each of the test cities (Fig. 4, 5, 6, and 7). Obviously, such possible improvement in the elimination of the summer valley problems deserves critical study by any interested company and, unless other conditions prohibit, represents potential incremental business worth getting.

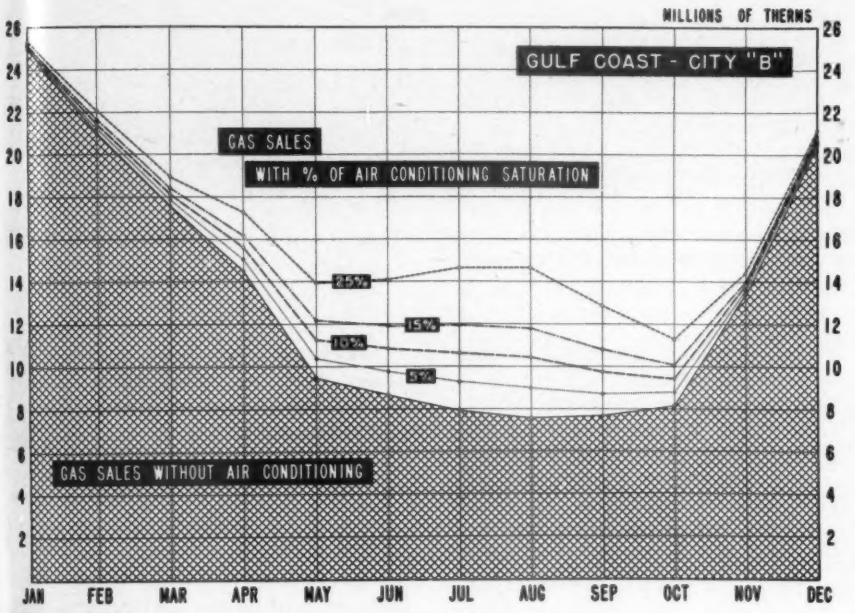


FIG. 4. Estimated 1958 monthly gas sales and incremental monthly sales attributable to various gas air conditioning residential saturations.

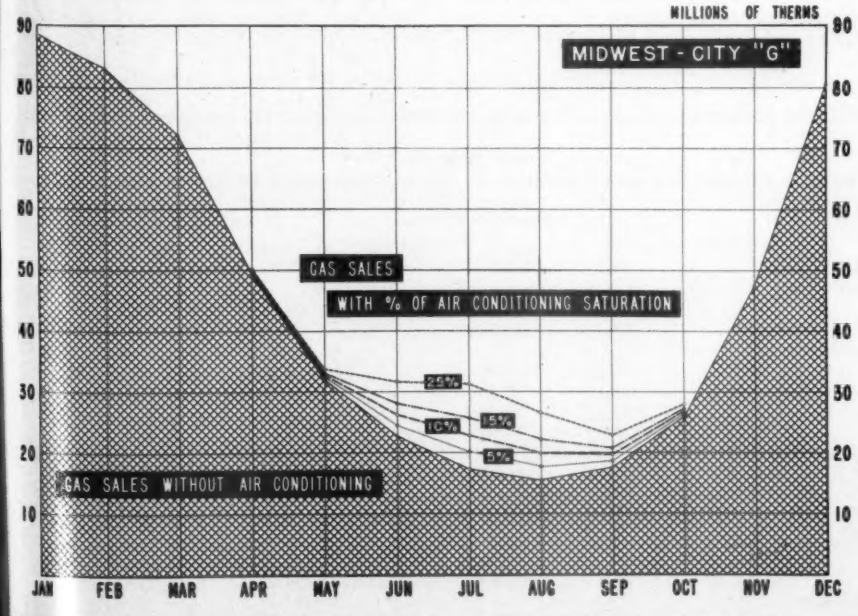


FIG. 5. Estimated 1958 monthly gas sales and incremental monthly sales attributable to various gas air conditioning residential saturations.

Consumer Interest

What about money matters of resi-

dential gas air conditioning, beginning with the all-important consumer? We must accept, as a premise here, the fact that residential air conditioning service is highly competitive. Having determined, the annual energy needs for air conditioning in the 12 test cities, how does gas compare on *existing gas and electric rates?*

In the calculations represented in Fig. 8, both as to gas and electricity, air conditioning use has been considered incremental above a normal, residential base load (generally a base load of 50 therms for gas), and rates currently published and available have been applied in each instance. You will note that we have calculated the money differentials on both the 4½ to 1 energy ratio now assumed, and also on the 3 to 1 energy ratio, which is prospective.

Please observe not only the absolute dollar savings — in most instances on the gas air conditioning — but also the relative amount of gas savings in comparison with the electric energy costs. These gas savings generally appear significant from the consumer viewpoint.

Fig. 7.
Percent Increase in Monthly Sales Created by a 25 Percent Residential Saturation of Air Conditioning.

	City B	City G	City J
January	1.5	—	—
February	5.0	—	—
March	7.6	—	—
April	19.1	1.6	2.0
May	47.3	5.6	11.1
June	62.1	39.3	47.7
July	84.0	80.8	83.6
August	93.0	70.4	78.3
September	67.1	30.2	63.6
October	38.1	7.6	10.2
November	7.4	—	—
December	3.2	—	—

Rates

In the matter of establishing special rates for residential air conditioning, many of the gas companies enjoy an advantage not shared by their electric opposite. I refer to those companies whose incremental cost of air conditioning is less than their average cost of gas. To illustrate this situation among the 12 cities, note Fig. 9, where we have used as the cost of air conditioning gas the following:

1. The company's average cost of gas under its one part rate; or,
2. The company's commodity cost *only* under its two part rate.

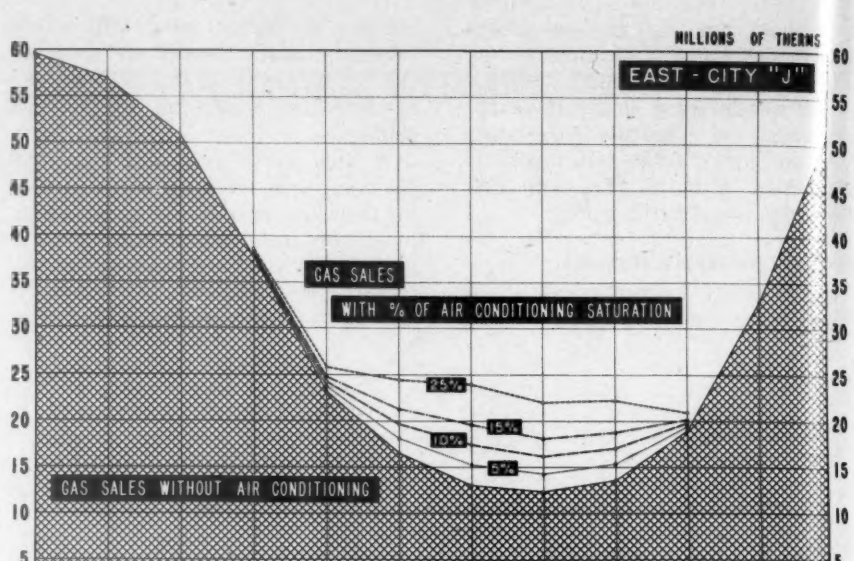


FIG. 6. Estimated 1958 monthly gas sales and incremental monthly sales attributable to various gas air conditioning residential saturations.

These have been compared, in each case, with the annual average cost of gas for the particular company.

In its study of competitive energy costs for residential air conditioning, the Task Force did not undertake to speculate on the future levels of the two rates. Certainly, there is no current indication of a general and long term trend of lower rates for either service.

A given electric service company, within limits, may adjust its rates to accomplish a specific purpose, i.e., lower rates to encourage electric heating, or raise rates to discourage peak electric air conditioning.

Many gas companies, as indicated above, may have inherently greater financial flexibility to establish lower and promotional rates to encourage gas air conditioning. Pertinent local factors must, of course, be carefully studied.

Initial Cost

The matter of comparative initial costs of existing gas and present electric residential air conditioning equipment cannot be overlooked. Unlike the commercial applications, a significant initial cost saving in residential electric equipment is presently possible in most markets. Clearly, these are problems

Fig. 8.
Gas and Electric Seasonal Operating Costs, for Air Conditioning, at Current Rates.

City		4½—1 efficiency differential			3—1 efficiency differential		
		Gas	Electric	Saving for gas	Gas	Electric	Saving for Gas
Gulf Coast	A	$47.59	$129.66	$82.07	$32.66	$129.66	$97.00
	B	55.70	100.86	45.16	38.64	100.86	62.22
South	C	45.56	111.42	65.86	31.34	111.42	80.08
	D	41.88	27.69	(14.19)	28.30	27.69	(0.61)
	E	42.12	48.94	6.82	28.08	48.94	20.86
	F	27.00	73.86	46.86	18.00	73.86	55.86
Midwest	G	34.88	60.10	25.22	23.26	60.10	36.84
	H	22.83	33.76	10.93	15.23	33.76	18.53
	I	17.75	28.82	11.07	11.83	28.82	16.99
East	J	63.35	57.78	(5.57)	42.24	57.78	15.54
	K	39.31	46.62	7.31	26.31	46.62	20.31
Mountain	L	1.58	5.48	3.90	1.05	5.48	4.43

for precise information and decision by the individual gas companies.

While the expanding equipment market for residential gas air conditioning indicates a reduction or possible elimination of such initial consumer investment differentials, two other approaches are available to a given gas company in a sensible effort to improve its residential air conditioning load.

One of these, obviously, is to **establish promotional air conditioning rates** even more favorable to the consumer than the present general rate structures. The other would be a **subsidy approach** in some form that might well be justified on a temporary basis in view of a company's potential net income increment.

Fig. 9.

Average Cost of All Gas Purchases, and Cost of Gas Attributable to Air Conditioning.

(cents per therm)

City		Average Gas Cost	Air Conditioning Gas Cost
Gulf Coast			
	A	1.56	1.56
	B	1.15	1.15
South			
	C	0.99	0.99
	D	2.43	1.96
	E	2.53	1.66
	F	0.99	0.99
Midwest			
	G	2.95	1.70
	H	2.77	1 96
	I	3.59	2.29
East			
	J	4.57	3.07
	K	3.52	2.70
Mountain			
	L	2.91	1.95

Servicing Equipment

The problem of servicing residential air conditioning equipment was also reviewed by the Task Group. Historically, and on the basis of the earlier types of equipment, it appears that concern over excessive service requirements had considerable justification. Newer equipment, on the other hand, with less complex and more rugged controls apparently offers much amelioration of service requirements.

The Task Force believes that neither gas nor electric residential air conditioning equipment can be service-free, if it is to perform properly its intended function over an extended time. The most reasonable approach seems to be that adopted by a growing number of gas companies, which is to sell the consumer a service policy, along with the sale of the equipment.

Experience does not yet establish clearly the dollar amount of the annual service contract that will recoup the average service costs, but there are many indications that an annual amount representing between two to three percent of the equipment cost to the consumer will be considered reasonable by him, and, at the same time, return to the gas company its direct service expenses.

Producing Income

We now come to the incremental net income projections that the calculations of the Task Force indicate a typical residential air conditioning consumer will produce in the 12 test cities. As discussed earlier, these are based on conservative gas consumption estimates and equipment efficiencies, and on current rates and gas costs (Fig. 10).

Fig. 11 calculates what would have happened to the net profit picture of the gas companies, in the 12 test cities, if they had enjoyed in 1957 a 25 percent saturation of residential gas air conditioning. The Task Force believes you will be impressed.

Perhaps it is not the function of the Task Force to draw any large conclusions from its studies. The problems in this area remain, of course, for individual company concern and solution. We do suggest that the data presented here should encourage the separate companies to make their own studies.

As a minimum summary, the Task Group finds very substantial basis for the gas companies in most service areas to consider the aggressive promotion of residential gas air conditioning at this time and concurrently to expend reasonable company funds in the support of research and development for the future.

Acknowledgment

This article prepared from a presentation made at the AGA General Management Section Spring Conference, Washington, D. C., April 1958.

Fig. 10.

Net Profit Per Customer From Gas Air Conditioning, at Current Rates.*

City		Revenue	Consumption (therms/season)	Cost	Net Revenue	Income tax (52%)	Net profit†
Gulf Coast							
	A	$47.59	1,160	$18.10	$29.49	$15.34	$14.15
	B	55.70	1,030	11.80	43.90	22.83	21.07
South							
	C	45.56	815	8.10	37.46	19.48	17.98
	D	41.88	700	13.75	28.13	14.63	13.50
	E	42.12	650	10.80	31.32	16.29	15.03
	F	27.00	540	5.35	21.65	11.26	10.39
Midwest							
	G	34.88	510	8.65	26.23	13.64	12.59
	H	22.83	240	4.70	18.13	9.43	8.70
	I	17.75	205	4.70	13.05	6.79	6.26
East							
	J	63.35	505	15.50	47.85	24.89	22.96
	K	39.31	330	8.90	30.41	15.81	14.60
Mountain							
	L	1.58	40	0.80	0.78	0.41	0.37

*Assuming current 4½-1 efficiency differential in calculating consumption.
†Assuming that servicing costs are covered by service.

Fig. 11.

Effect on Net Profit of 25 Percent Air Conditioning Saturation.

City	Net profit per customer from air conditioning*	25% of total residential customers	Incremental net profit	Resultant % gain in 1957 net profit
Gulf Coast				
A	$14.15	37,700	$ 534,000	+68.2
B	21.07	56,300	1,186,000	+63.1
South				
C	17.98	173,500	3,119,000	+16.6
D	13.50	33,600	454,000	+30.5
E	15.03	73,000	1,098,000	+42.7
F	10.39	80,600	838,000	+15.0
Midwest				
G	12.59	87,800	1,106,000	+25.1
H	8.70	234,200	2,038,000	+19.1
I	6.26	47,300	296,000	+ 8.5
East				
J	22.96	83,800	1,924,000	+46.6
K	14.60	239,000	3,489,000	+55.2
Mountain				
L	0.37	53,900	20,000	+ 0.8

*Based on current gas rates and costs.

In Chattanooga, the big switch is to GAS . . .

CASE HISTORY

Arkla-Servel Year-Round Units Replace 17 Heat Pumps That Wouldn't Pump Heat

E. F. Davis
Sales Manager
Chattanooga Gas Company
Chattanooga, Tennessee

THREE HUNDRED ACRES of rolling green Tennessee countryside located a few miles north of Chattanooga began life anew as a modern home development in early 1956. The planning and building was done by developer Orlin Edwards, who had used gas heating and water heating in his last 68-home development project.

Edwards' new project, to consist of 300 homes, developed early into a battle of wits between salesmen for natural gas and electricity. Promises, promotion plans, guarantees and advertising plans were a "dime a dozen." Equipment for the new homes finally boiled down to a choice between gas heating and air conditioning units and electric heat pumps.

The developer, flown to the factory of a prominent electrical manufacturer, was highly impressed. Later, he was flown to the factory of the manufacturer of the gas heating-cooling units and was impressed with the quality of this product. At that time, the decision appeared to be in favor of natural gas. This choice remained until the developer was offered the electric heat pumps, completely installed, for less than $1800 each. The builder felt that at this price he could scoop the new home market. He was assured that the big electrical manufacturer would back him up if trouble was encountered.

In the late summer of 1956, the first homes with electric heat pumps were completed, at which time, the builder purchased more units. This time, at a higher price. Construction and sale of the homes was steady and a few problems were encountered during the abnormally mild winter of 1956-1957.

Good salesmen know their competitors' products as well as their own, so here we introduce Mr. Prince, natural gas salesman deluxe, who had his eye on every ant that crawled over the heat pumps.

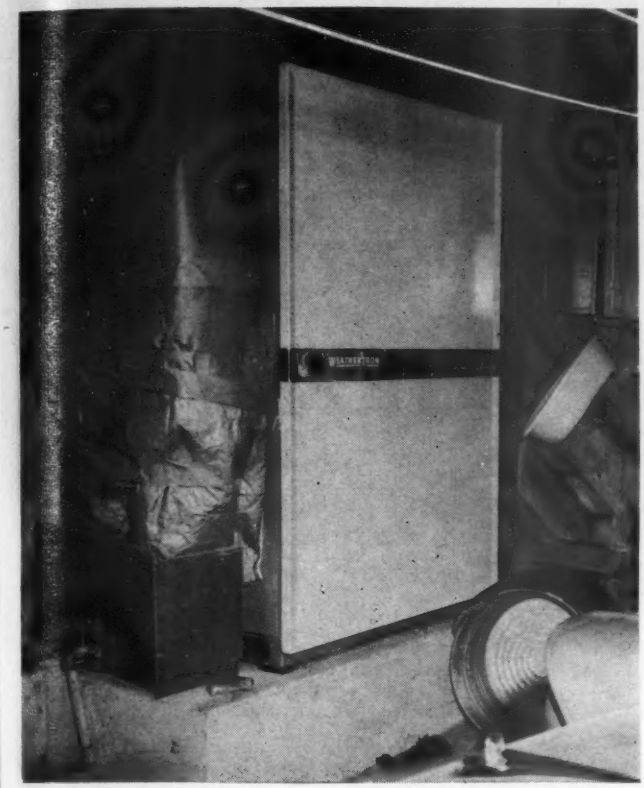
Developer Edwards was aware of no particular problems with the electrical units until one morning in December 1957, when he awoke to find the heat pump in his own home not working. For nearly a week he heated his home with resistance heat (with a 10-kw load) until a replacement unit could be obtained. Suddenly, he began to hear from others who were having similar troubles. Then, on January 1, 1958, he received a copy of a letter from one of the home owners directed to the manufacturer of the electric heat pumps stating:

"December 26, 1957, we awoke in a cold house. . . . The heat pump had gone out again. Another new cycle must be installed, which will be the fifth one. Since December 26th we have been getting heat from the auxiliary unit and to date (December 31) we are still on auxiliary heat, which, as you know, is very expensive to operate.

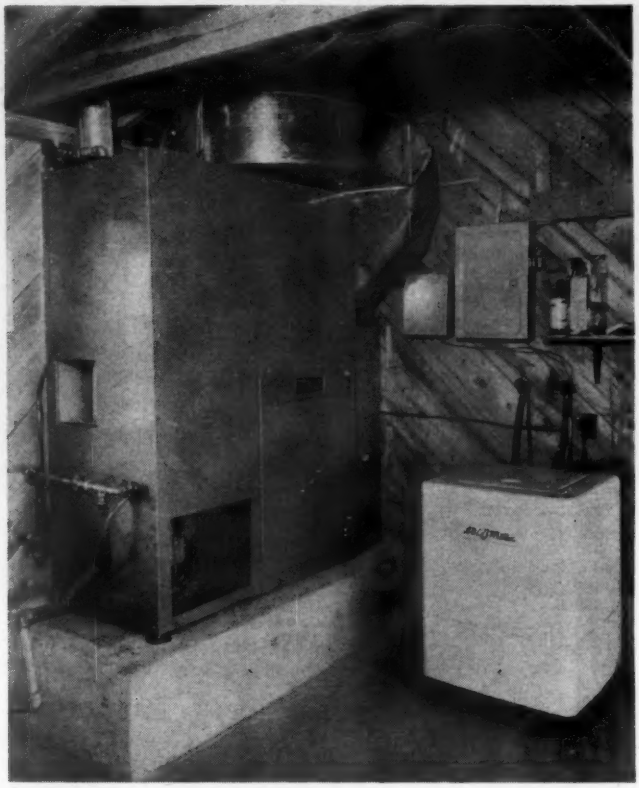
"In my letter of April 26, 1957, I expressed concern about the maintenance cost after the 12-months' service period ended. . . . We have been aggravated by a non-heating [unit] all of last winter and so far this winter. In view of our past experience with the [unit], I do not think we should be charged with service calls until we have been through a heating season without any trouble.

"Page 2 of the owner's manual states in part 'the large capacity fan operates slowly, smoothly, quietly.' This is not true . . ."

Gas Air Conditioning Roundup



BEFORE... Electric heat pump as originally installed.



AFTER... New Arkla-Servel unit is ideal replacement.

Several days later the builder's own unit conked out again, requiring an overhaul for the second time in less than a month. This brought home the point that "all was not like roses."

With 23 heat pumps installed, more troubles began to develop and neighborhood conversation centered about non-working heat pumps.

Owners began complaining about the outdoor air-to-air coil frosting up, which cut off their heating. These coils accumulated so much frost that they would not automatically defrost, and during weather below freezing it was difficult to defrost them by any means. Others complained the inside air was too cold and drafty. Compressors were breaking down and replacement units were hard to come by. Some had to wait three weeks to obtain new units. In all, 19 complete cycles were replaced over the 18-month period. Some defrost drains froze up, causing water to overflow into the blower compartment and freeze.

All this might not have been so bad but these alleged economical heat pumps sent the "cheap TVA electric bills" skyrocketing. Bills of $55 and $65 per month were not uncommon for the homes that were 1800 to 2000 sq ft of floor space.

At this point, the builder turned to the prominent electrical manufacturer and the municipal electric people for some of the promised help that he expected from them. Promises were received to "provide a stock of replacement cycles in Chattanooga that will be available solely to the owners of homes in your development."

The manufacturer of the electric heat pumps said it would "absorb the excess costs—" for use of resistance heating. In addition, a representative of the electrical manufacturer wrote:

"I'm sure you feel that the [*units*] *(when they are operating properly) provide the finest—or you wouldn't have bought them in the first place."*

Builder Edwards finally asked the big electrical manufacturer to replace the heat pumps with gas furnaces and electric air conditioning or he would take the matter in his own hands. He received many phone calls, both long distance and local, and many visits, but he was forced to decide they were just "visitin."

About this time, a "Good North Wind" sent the sunny South into a state of frozen frenzy, with ice and snow and temperatures ranging from 0 to 5 deg above. This not only put the gas company back in business, but set Mr. Prince up for the long awaited killing, as the weather was playing havoc with everything but natural gas.

Now, Mr. Prince is a very persistent salesman and had stayed with Edwards all through his terrifying heat pump miseries. Instinctively, with tact, diplomacy and salesmanship, he sold the builder that only Arkla-Servel Sun Valley units could satisfy the home owners, who thought they had bought the "ultimate" in their heat pumps.

Builder Edwards then made arrangements with gas company officials to purchase Sun Valley units that would be installed to replace the troublesome heat pumps.

Developer Edwards then sent the following letter to the owner of each heat pump equipped home:

Dear Mr. Jones:

At the time we purchased the [*electric heat pump*] heating air conditioning unit for your home we thought it was the best year-round unit we could buy. The air conditioning proved to operate very good, however, I regret to say (based on the record) the heating has been unsatisfactory. Of the 23 machines presently in operation 15 compressors have burned out. As these units failed [*the manufacturer*] replaced them with used and reworked compressors. The time required to get the unit replaced varied with each job. The average life of the compressor has been 7 to 8 months.

In addition to this problem some of the coils have iced-up from time to time.

Have gas, will service. Gas company crew lays line to serve owners who have switched to gas heating and cooling.

In order to eliminate this inconvenience to you I have asked the [*electric manufacturer*] to replace your [*heat pump*] with [*a*] combination gas heating and electric cooling unit. They refused my request.

I feel it is time for concrete action and after much deliberation here is my proposal to you. If you desire, your [*heat pump*] will be replaced free of charge with an ARKLA-SERVEL 3-ton heating and cooling unit. This unit has no compressor to break down or wear out. While your annual operating cost will run a little more, you would save money in the long run, due to the 10 to 20-year expected life of the ARKLA-SERVEL equipment.

I extend to you the privilege of making your choice.

Sincerely,
Orlin Edwards, Builder

I request that my [*heat pump*] be replaced with a SERVEL unit.

Signed.....
Home Owner

I do not prefer to have my [*heat pump*] exchanged.

Signed.....
Home Owner

This letter created considerable comment and within a few days, each home owner received a letter from the local municipal electric utility people stating:

". . . there has been considerable trouble with the [heat pumps] installed in Lake Hills.

"It is our understanding that [the manufacturer] intends to stand back of every installation that has been made. If you have any troubles or complaints, Mr. . . ., Service Manager for the southeastern district, will be in town this week to hear them.

"Please do not do anything rash until that time . . ."

Of the 23 heat pump units originally installed, 17 of them were replaced by Arkla-Servel units at the owner's choice. Two of the six who did not choose replacement were employed by TVA, one owner had not moved in, and one home is a church parsonage tied up in committee.

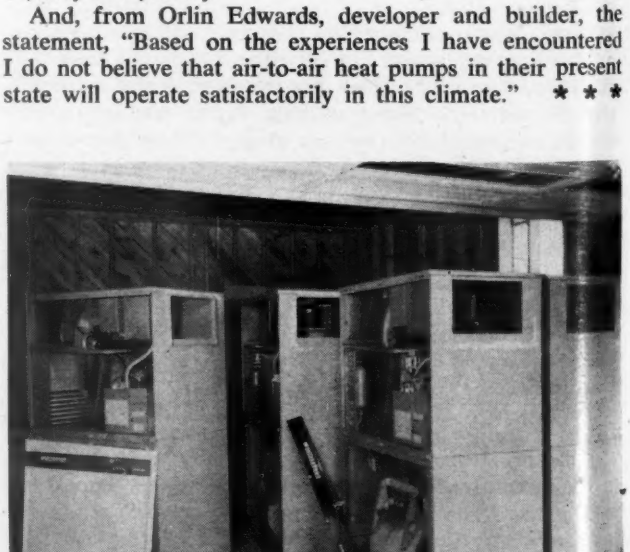
The gas company, desiring to have its equipment perform its best on the duct system installed, tested the Arkla-Servel unit in one of the homes for sale until company engineers were satisfied. The wheels of progress turned out an Arkla-Servel to replace a heat pump every working day, and in 24 days, the 17 new Arkla-Servel units were installed as heat pump replacements, with four more in new homes.

All installations are now complete. Many complimentary letters have been received from those home owners who changed to Arkla-Servel. Such comments:

"It certainly is an improvement over the heating unit I had . . . a much quicker and warmer heat, and a pleasant and surprising thing to me is, it is practically noiseless."

"It is much quieter in operation and has been perfectly satisfactory."

And, from Orlin Edwards, developer and builder, the statement, "Based on the experiences I have encountered I do not believe that air-to-air heat pumps in their present state will operate satisfactorily in this climate." * * *



Electric heat pumps that have seen better days, gather dust awaiting ultimate disposal.

OPEN CYCLE? **closed cycle?** JET UNIT? **external combustion engine?** FREE PISTON?

RESEARCH: *Key to the future of gas air conditioning*

Here's a report from the 1958 AGA Research and Utilization Conference discussing what's happening in the labs and shops that will help build future summer loads

Robert B. Smith
Manager, Air Conditioning Research
American Gas Association, New York, New York

IN 1954, a committee called the Task Group for Air Conditioning Research was formed from within the gas industry and was charged with an important responsibility, i.e., to develop at the **earliest possible moment** equipment that would strengthen the gas industry's position in the air conditioning picture.

First action of the Task Group in 1954 was to have prepared by A. D. Little and Battelle Memorial Institute two surveys to review the gas air conditioning field and to recommend logical approaches to the problem. The resulting reports, which were distributed to the industry, indicated several paths of attack, including the use of internal combustion engines as a potentially quick realizable solution. Also, during 1954, conferences were initiated with individual manufacturers who were known to be engaged in or potentially interested in gas air conditioning with the objective of encouraging their efforts or entrance into this field. These contacts have been maintained subsequently, and will be continued in the future.

In 1955 a broad attack on the problem was initiated. One of the primary objectives was to obtain basic research data that would be of assistance to the manufacturers. Eleven projects were initiated as shown in the accompanying table.

During 1956, four of these projects were completed with reports issued to the industry and two projects were suspended after a study of preliminary results indicated questionable feasibility. An additional two projects were closed with the results furnished to the interested manufacturers. Also in 1956, five projects were initiated, of which two were completed and one was suspended in 1956.

1957 Program

At the beginning of 1957, the program was narrowing down such that the major effort was concentrated on four developments all aimed at operating prototypes suitable for testing and/or presentation to manufacturers. In March 1957, the PAR Committee of AGA felt that the program should be accelerated in view of the fact that no marketable prototypes had as yet been produced by the manufacturers although indications were that they were making good progress. An additional $375,000 was allocated to the program for this acceleration.

This acceleration was authorized primarily because two of the interested manufacturers, the Rheem Company and the Coleman Company were unable, for business reasons, to carry on their research programs as planned. In view of this, AGA and Rheem agreed to a cooperative program to carry out a test program of Rheem's jet unit.

The Coleman Company, which carried out over a period of four years an extensive research program with a net expenditure of more than $1,000,000, turned over the development of its research projects to AGA for inclusion in the PAR program. These projects included developmental work on a combined engine-compressor unit in cooperation with the D. W. Onan and Sons; an open cycle wet absorption system under development at IGT, and work on jet fluids to enable better design such as air cooling.

The open cycle wet absorption unit operates on the principle of drying the hot humid air from the conditioned space by direct contact with a liquid sorbent, in this case triethylene glycol. The air is then cooled partially by sensible heat removal utilizing a coil and cooling tower and finally rehumidification by direct water spray which provides additional cooling. A ¼ scale unit was used to obtain test data.

These projects were all incorporated in the 1957 PAR research program. Also, during 1957 test facilities were built at the AGA laboratories in Cleveland to be used in laboratory testing of all types of gas air conditioning units. An ignition study was initiated at Battelle aimed primarily at improved ignition systems for the free piston unit. In addition, the Task Group was well aware of the swing to air cooled condensers in electric air conditioning units, and therefore in 1957 initiated a project concerned with the development of better absorbent-refrigerant combinations for air cooled absorption units.

Swiss Unit Demonstrated

The goal of the Task Group came much closer to reality in November 1957, when the Swiss 'sorption unit was demonstrated to a limited number of manufacturers and business negotiations with interested companies were initiated. Currently, one manufacturer

has agreed to work with the Swiss group in further development. This development is the result of more than six years work by a Swiss group and is based on the well-known process of first drying the air to be conditioned to a very low relative humidity, and then reevaporating the moisture into the air to evaporatively cool the conditioned air. This basic scheme has been investigated by many individuals the world over.

The Swiss group has concentrated its work on three basic problems:

A. The creation of an air drying device which in comparison with previous drying equipment is:
   1. Lower in first cost,
   2. Has a lower air resistance,
   3. Retains the ability over a long period of time to dry air to the range of 3 to 4 percent relative humidity.

B. A method of sensible heat transfer which is:
   1. Less expensive than finned coils and circulating fluids,
   2. Capable of at least 85 percent sensible heat exchange,
   3. A pressure drop that is within practical limits.

C. The choice of a psychrometric cycle which utilizes the dryer and sensible heat exchanger developments in (A) and (B) above in a manner which will make possible:
   1. A reasonably compact all-year air conditioner,
   2. Elimination of a cooling tower,
   3. An operating cost which will be sufficiently competitive with the already highly developed electrical compression systems.

More than 20 cycle variations have been evaluated. Several of these have been translated into working models, one of which was given a very brief field test in August 1957. This unit possessed a unique ability to do either a latent or a sensible cooling job.

Evaluation of the field test results indicated the desirability of still further modifications in the psychrometric cycle. These modifications have been developed and are being incorporated in a later model. At least an additional year of study and field testing will be required to evaluate the latest approach, however, this is concrete progress.

1958 Program

For 1958, two additional projects in operating prototype form were demonstrated to interested manufacturers this year. During the week of January 13, 10 manufacturers were represented at a showing of the improved absorption system at the Southwest Research Institute in San Antonio, Texas. Several of these manufacturers have indicated an interest in the unit and have subsequently made a cost study of the unit.

During the week of March 17, another important milestone was reached when a demonstration of an operating laboratory prototype of the free piston unit was held in Columbus, Ohio, for 29 appliance and engine manufacturers. Interest was high — and negotiations as to possible licensing arrangements are now in the preliminary stages.

Five projects are continuing in 1958 with the open cycle wet absorption system in IGT now in the final phase. A phase report is being prepared, which will be studied by the Task Group to determine future steps to be taken. A new project initiated in 1958 is concerned with an evaluation of an external combustion air pump or compressor, which was developed by Professor O. A. Carnahan of Syracuse, New York. This evaluation is still underway, and no details are available.

During 1955 a total of $222,000 was expended; during 1956 the expenditures were increased to $430,000 and in 1957 to $580,000. The budget for 1958 authorizes funds of $500,000.

Future Research

Work to date has been concerned primarily with the refinement or improvement of old ideas and with carrying these refinements to the operating prototype stage. It appears that now is the time to approach the problem in a more basic manner in an attempt to come up with a new or novel idea. This basic approach is included in plans for 1958, and the Task Group would be very happy to hear from any one who might have such an idea. * * *

PAR Air Conditioning Research Program
1955 to 1958 (as of March 31)

Project	Agency or cooperating developer	1955	1956	1957	1958
1. Absorption Cycle—Internal Corrosion	IGT	Initiated	Closed	—	—
2. Absorption Cycle—Noise Study	AGA Labs.	Initiated	Closed	—	—
3. Absorption Cycle—Thermodynamics	John Hopkins	Initiated	Completed*	—	—
4. Absorption Cycle—Literature Review	IGT	Initiated	Completed*	—	—
5. Internal Combustion Engine—Development of Specifications	Battelle	Initiated	Completed*	—	—
6. External Combustion Engine	Battelle	Initiated	Continued	Closed	—
7. Free Piston Engine—Compressor	Battelle	Initiated	Continued	Continued	Demonstrated
8. Double Loop System	Battelle	Initiated	Suspended	—	—
9. Jet System Principles	Stanford	Initiated	Completed*	—	—
10. Sorption (Swiss) Unit	Lizensia	Initiated	Continued	Demonstrated	—
11. Azeotropic Principles	Battelle	Initiated	Suspended	—	—
12. Long Life Engine	Continental	—	Initiated	Continued	Continued
13. Evaluation of Gas Fueled Heat Pump	A. D. Little	—	Initiated & Completed	—	—
14. Evaluation of Gas Fueled Heat Pump	Southern R. I.	—	Initiated & Completed	—	—
15. Improved Absorption System	Sw. R. I.	—	Initiated	Continued	Demonstrated
16. Double Loop System—Use of Vaneless Turbocompressor	Battelle	—	Initiated & Suspended	—	—
17. Open Cycle Wet	IGT	—	—	Initiated	Final Phase
18. Field Test of Rheem Jet Unit	Rheem	—	—	Initiated	Continued
19. Capacity Testing	AGA Labs.	—	—	Initiated	Continued
20. Engine-Compressor Unit	D. W. Onan	—	—	Initiated	Continued
21. New Absorption Fluids	Battelle	—	—	Initiated	Continued
22. Jet Fluid Studies	Ohio State U.	—	—	Initiated	Completed
23. Free Piston Ignition Study	Battelle	—	—	Initiated	Demonstrated
24. External Combustion Air Engine	Battelle	—	—	—	Initiated

*Report Available

Cathodic Protection Difficulties Involved in Iron-Bound Compression Couplers in Gas Distribution Systems

John Emery,
Assistant General Superintendent
Rio Grande Valley Gas Company
Brownsville, Texas

ONE OF THE most troublesome aspects of applying cathodic protection to a gas distribution system, and keeping the protection applied, lies in keeping compression couplers in steel-welded lines bonded, so that a continuous path is provided metallically for protection current to flow to the drainage points.

Rio Grande Valley Gas Company, since 1952, has applied reasonably complete cathodic protection to 16 distribution systems. Three of these systems are protected by rectifier current, one with a combination of rectifier and magnesium anode current, and the rest by the use of magnesium anodes in sizes from 9 to 50 lb.

One of the most time consuming and expensive portions of such a cathodic protection program, when protection is initially applied, is the location of underground compression couplers and bonding these couplers externally. Why weren't these couplers bonded as they were installed? The answer is that RGV's program of bonding all couplers started as late as 1953 and literally thousands of such couplers were installed from 1927 to 1953.

Some of these couplers are rather easily located by the use of pipe-locators and difference of potential between test points. In applying cathodic protection, all couplers which can be located in this manner are bonded externally by brazing a copper wire to the coupler and to the pipe on each side.

Unfortunately, a number of couplers in any distribution system at any given time are "iron-bound." That is, the metal of the pipe is in good contact with the metal of the coupler or the ends of the pipe are in contact inside the coupler. These couplers will not usually be found, because a signal from a pipe-locator passes through, and ordinarily no drop in potential, or a very small drop, is detectable with field potentiometers.

Fig. 1 shows a simple sketch of an open or unbonded coupler and Fig. 2 shows a sketch of iron-bound couplers.

Why worry about these couplers, then, if they pass current in reasonable amounts? These couplers do not always stay "iron-bound" and such things as heavy rains can cause enough shifting of the soil to cause the couplers to "open." Sometimes the bond becomes a poor or high-resistance bond, which from a cathodic protection point is almost as bad as an open coupler. This type of bond or partial bond does not allow sufficient current to pass, although some current will pass.

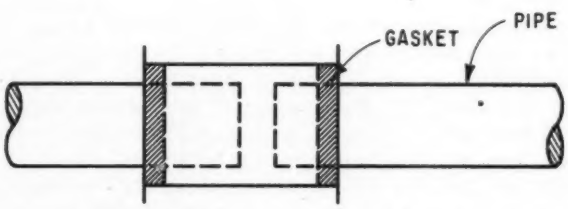


FIG. 1. **Sketch** of unbonded, open coupler.

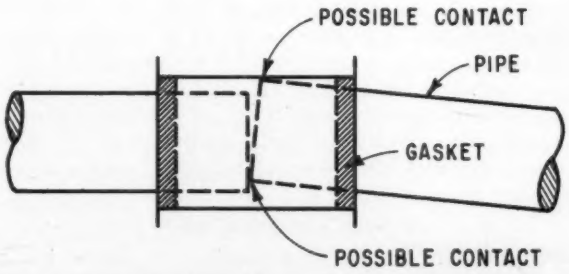


FIG. 2. **Sketch** of iron-bound coupler.

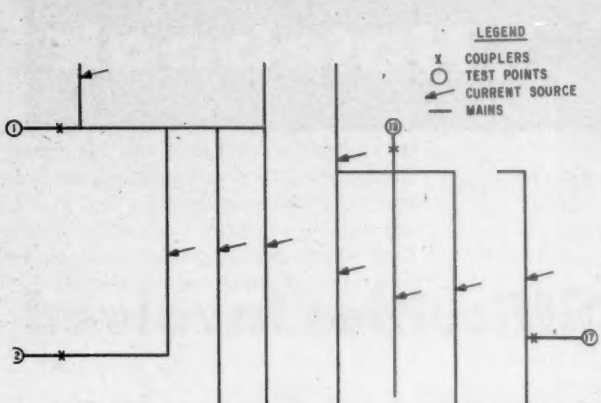


FIG. 3. **Layout sketch** of section of San Benito, Texas, gas distribution system.

Test point number	P/S readings in Nov. 1956	P/S After bonding couplers
1	.38	1.32
12	.67	.99
17	.44	1.04
19	.48	1.04

FIG. 4. **Pipe-to-Soil Data** at test points shown on Fig. 3 before and after bonding open couplers.

How are they discovered and what can be done about such couplers that open? Taking pipe-to-soil readings at many test points on all systems, under protection as often as possible, indicates such open couplings. The remedy is to bond these open couplers and continue to take frequent pipe-to-soil voltage readings. Over a period of a few years you can reasonably expect to find most of these couplers missed in the original bonding job.

Case History

Pipe-to-soil readings taken in San Benito, Texas, in late 1956 showed four low points in the northern portion of this system. Layout of this portion of the San Benito gas distribution system at that time is shown schematically in Fig. 3. The Fig. 4 shows pipe-to-soil readings at these four test points before and after finding and bonding these couplers which had "opened." This system was originally put under cathodic protection in 1955, using magnesium as a current source. In 1957, three more such couplers in this same system were found in a different section of town.

It may be noted from these readings that considerable variance is obtained even after bonding these couplers, but the entire system is not electrically continuous and should not be. To make an entire system continuous would be causing future headaches if accidental contacts were to develop or insulators fail. The search for such things would be spread over a much greater area.

Case History

Pipe-to-soil readings on the distribution system in Raymondville, Texas, during 1957 indicated open couplers in the southwest section of the system. This section is shown schematically in Fig. 5 and pipe-to-soil readings before and after bonding the couplers indicated on the sketch are given in the table in Fig. 6. This system was put under protection in 1954 and couplers that have "opened" have been found each subsequent year.

It may be seen from pipe-to-soil readings in Fig. 6 that when all of these couplers were bonded, all readings below .85 came up, but one of the higher readings came down. That is, current was being more evenly distributed from the same sources.

At this point, it should be made clear that this difficulty is encountered only on older systems whose compression couplers were not bonded at the time of installation. RGV systems being laid now and all new and replacement work on mains and services have had no unbonded couplers since 1953. All couplers now being installed are bonded at the time of installation.

These iron-bound couplers that open at a later date point up one reason for saying we have applied **reasonably complete** cathodic protection on a system.

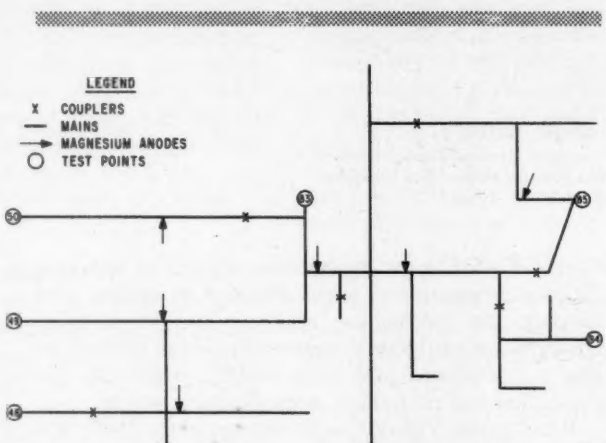


FIG. 5. **Layout of section** of Raymondville, Texas, gas distribution system.

Test point number	P/S readings in Nov. 1957	P/S After bonding couplers
47	.75	1.15
48	.68	1.01
49	.82	.96
50	.94	1.02
83	.84	.98
84	.64	.98
85	1.30	.94

FIG. 6. **Pipe-to-Soil Data** at test points shown on Fig. 5 before and after bonding open couplers.

Another reason for this statement is that, to definitely establish the fact of complete .85-v pipe-to-soil protection, would require the testing of every foot of pipe involved in each system. This is an impossibility; we feel that protection applied that gives a pipe-to-soil reading of .85-v pipe-to-soil at each service riser on the system is **reasonably complete** protection.

Those couplers that tend to "open" at various times, illustrate very well that cathodic protection of such gas distribution systems is not a static condition and such protection requires a good deal of testing and adjusting to be maintained at a reasonable level. * *

Current considerations in

Peak Shaving Economics

M. F. Hall, *Gas Engineer*
Ebasco Services, Inc.
New York City, New York

A REAPPRAISAL OF THE ECONOMICS of peak shaving is vital for gas companies in the South as well as elsewhere. The increasing costs of gas supply require a careful examination of the economics of all possible peak shaving methods in order to maintain proper earnings. Peak shaving in the gas industry has been defined as "supplying gas to a system from an auxiliary source, during a period of maximum demand, to reduce the demand on the primary source of supply." Peak shaving also improves the load factor of the primary source of supply.

This article discusses, primarily, the peak day gas supply for local gas utility situations in the southern states. Peak shaving of maximum daily demands is becoming increasingly important, not only as an assurance that good service to customers will be maintained, but also to obtain the lowest cost of gas supply. Requirements for residential space heating gas are increasing, causing new high daily demands on extreme cold days. Natural gas transmission pipeline costs are going up, resulting in higher demand charges. It is fortunate that the gas industry is growing rapidly, but its very growth brings many problems.

Of course, many southern communities are fortunate enough to be located close to major gas producing areas and do not have to pay long distance transportation costs for gas. Their demand costs have been too low to require peak shaving. Moreover, many communities are too small to afford the investment in a peak shaving plant and can purchase all their gas at a one part commodity rate. Each utility should study its particular peak shaving economics as its load and demand conditions change.

Very likely, many gas distribution companies will consider the installation of additional peak shaving facilities based upon the 1957-58 winter experiences. The severe and prolonged low temperatures and new peak loads will be remembered by gas men for a long time. Throughout most of the South, from Texas to Florida and up the eastern seaboard to the Potomac River, February 1958 was the coldest month in many years.

New high demands caused transmission pipelines and peak shaving plants to operate at maximum capacity. Overrun of purchase contract demands occurred in some places, necessitating payment of increased demand charges. Some companies ran out of propane stored for peaking purposes and it was necessary to exhaust all possibilities of emergency deliveries to save the day.

Peak Shaving Economic Studies

Economic studies of peak shaving are concerned primarily with gas volumes and costs. Volumes are related to daily demands and seasonal consumption of gas for space heating purposes. Past sendout and other records can be used to determine cold weather daily demands and total annual consumption for the average residential space heating customer in the system of a given community. Experience has shown that the demand for space heating gas is practically a direct function of the number of degree days, either daily or annually.

Average space heating demand per degree day tends to be greater in warmer climates, because relatively lower heating costs do not justify greater heating economy measures. For example, the average demand per degree day (65 F basis) per residential heating customer might be around 23 cu ft for natural gas for a city in a cold climate having about 7000 degree days a year. For southern areas, having around 1500 annual degree days, the unit demand per residential customer might be in the neighborhood of 29 cu ft.

Where the volume of gas required depends upon space heating, the effect of cold weather on load may be determined by constructing a chart of total demand versus number of degree days. The trend line usually may be drawn as a straight line, which can be projected to show the demand for the number of degree days for the coldest day which may occur in the future.

Studies of records of daily degree days for the past 20 or 30 years will show the coldest weather conditions in the past and the probabilities for future maximum daily degree days. It may be advisable to provide peak shave plant capacity to take care of a future cold day equal to the coldest on record. On the other hand, a somewhat lesser daily demand may be adopted for design purposes where it is not considered economically feasible or in the customer's interest to overbuild peak supply facilities.

Cost studies of the economic feasibility of peak shaving for a given set of conditions should use methods which find quickly and accurately the amount of peak shaving that gives the lowest total annual cost. One such method is described briefly in this article. This method is based upon using a formula to find the weather, temperature, or load conditions where peak shaving should begin. The formula uses the two part rate concept of demand cost and commodity cost to determine the amount of peak shaving that provides the minimum total annual cost of gas supply.

Gas Supply Costs

Costs of all kinds of gas supply may be stated in terms of their **demand cost** and their **commodity cost per Mcf.** For example, the **demand cost of natural gas,** which we will call the

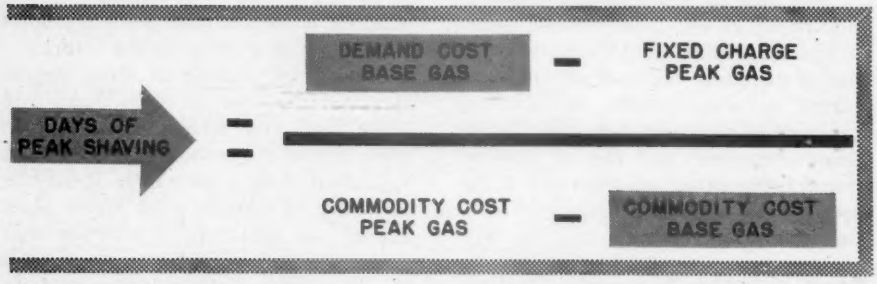
base gas, usually is the stated contract cost for a given maximum day demand. The **demand cost for peak shave gas** may be the annual fixed charges, such as depreciation, taxes, earnings, etc., on the peak shave plant investment per Mcf of daily capacity.

Commodity cost for natural gas per Mcf of gas purchased is given in the contract. The **commodity cost** of any type or source of peak shaving gas may be obtained from a proposed supplier, operating experience, or may be estimated. It is the production cost or expense per Mcf that depends upon the volume of gas supplied.

A convenient *Economic Point Peak Shave Formula* may be used to determine the number of days to peak shave for any given set of base and peak gas costs.

Formula for the Economic Point for Peak Shaving

The *Economic Point Shave Formula* is written as



The formula states that the **difference in annual demand costs per Mcf** between the base gas and the peak shave gas **is equal to the difference in commodity costs** of the two gases **times the number of days per year that one Mcf of peak shaving gives lowest annual costs.** The number of days to peak shave furnishes the clue to the point or temperature at which to begin the peak shaving process.

Sample Calculations

An example gives a better understanding of the formula. Let us assume the natural gas contract demand is $2.25 per month per Mcf or $27 per year. An assumed plant for producing peak shave gas might cost about $47 per Mcf daily production capacity and its fixed charges of 15 percent would be about $7 per Mcf. Commodity cost of the peak shave gas is taken at $1.45 per Mcf, and for natural gas its contract price of $0.20 per Mcf. Substituting in the formula and solving gives 16 days of peak shaving.

The formula proves, in effect, that if peak shave gas is made on more days, the cost of the combination of gases increases. On the other hand, if peak shave gas is made on less days, the increase in demand costs is more than the decrease in commodity costs.

Test of the Formula

An incremental change of one Mcf from the economic point for peak shaving may be used to test its effect upon the lowest cost mixture. The lowest number of days for peak shaving is reached when an incremental change in either direction increases the cost above the minimum.

Suppose 17 days instead of 16 were peak shaved. Commodity costs for the 17 days would be increased to 17 times $1.45 — $0.20 or $21.25, while demand costs would be reduced only by the difference between $27 and $7 or $20. The incremental move in this direction costs more for commodity than the saving in demand.

Likewise, for 15 days of peak shaving the net demand cost would increase $20, but the net commodity cost would decrease only to 15 times $1.25 or $18.75. Thus a reduction in peak shaving is not economic. Calculating the effect of incremental deviations proves the correctness of the findings of the *Economic Point Peak Shave Formula.*

Since commodity cost of natural gas is relatively low, it obviously should be the base load gas. Peak shave gas should have a relatively low demand charge, but may be permitted to have a high commodity cost. This is because peak shave gas usually is high in demand volume and low in commodity volume.

Now that we have found the number of days to peak shave in our example, the next step is to use this information to find when to start peak shaving as the weather gets colder. This requires the preparation of a Load Duration Table, from which a Load Duration Curve may be charted.

Example of a Load Duration Table and Chart

A typical Load Duration Table, sometimes called a degree day duration table, is simple to prepare yet difficult to describe. It is a listing of daily mean temperatures, beginning with the lowest, and the number of days per year for each successive mean temperature. The table may be for an average year for a selected period. The cumulative number of days and degree days for **colder** weather temperatures are listed opposite each mean temperature. In other words, **below** each mean temperature point or for **colder** temperatures there are a number of cumulative days and degree days due to such colder mean temperatures.

An example of a Load Duration Table and its accompanying Load Duration Chart are shown in the illustration on the next page.

A complete table does not stop at 23 deg mean temperature as in the sample but continues through 65 deg. The chart shows for each mean temperature the number of days in the year at lower mean temperatures. The peak shave gas area on the chart represents the number of degree days of colder mean temperatures below the 20 deg level, and is the same number as the cumulative degree days of colder temperatures shown in the fourth column of the table.

In the peak shaving sample calculations already discussed, the number of days derived from the *Economic Point Peak Shave Formula* was 16. This means than 16 days should be peak shaved. From the *Load Duration Table,* 16 cumulative days occur at mean temperatures below 20 deg. Therefore, base load gas should be supplemented with peak shave gas for space heating demands caused by lower mean temperatures than 20 deg.

If we assume that the consumption per degree day per average residential space heating customer is 23 cu ft, then total annual use of peak shave gas for such customer would be 23 times 56 deg days or 1288 cu ft. Required daily capacity of the peak shave plant per customer would be to meet the demand from 20 deg down to 12 deg, or 8 deg days. This plant capacity demand per residential space heating customer would be 23 cu ft times 8 deg days or 184 cu ft.

A study of peak shaving economics can be quite complicated. A situation theoretically could exist where it would be necessary to determine the best use of such sources of supply as:

Natural gas from two different suppliers.
Load factor restrictions,
Underground storage gas offerings,
Winter peaking service,
Emergency gas made available,
Propane-air gas production, and
Low pressure gas from existing storage holders.

Peak shaving of peak shaving gases is a real problem in some cities.

Principal Sources of Gas Supply

Now we can consider briefly some highlights for various principal sources of base load and peak shave gas supply. No attempt is made here to give estimates of demand and commodity costs for all of the various supply sources, as these estimates more properly can be made for each individual utility situation.

The basic supply throughout the South is, of course, natural gas delivered by pipelines. The contract with the supplier specifies demand charge and commodity price.

Demand and commodity prices in today's pipeline rates are currently controlled, in large part, by standards set up by Federal Power Commission's opinion in the Atlantic Seaboard case (Opinion No. 225-1952). While there are many who disagree with this concept, the fact is that the FPC has changed very little in more recent cases from these principles.

Peak Shaving Plants or Methods Employed

Peak shaving plants or methods may be classified in accordance with the following table:

A—Oil Gas Production Plants

B—LPG Plants
1. Storage Requirements
2. Propane or Butane-Air Gas
3. Hasche Converter

C—Natural Gas Storage
1. Low-Pressure Holders
2. High-Pressure Containers
3. Underground
4. Liquefied

D—Natural Gas Pipeline Winter Peaking Service

E—Methods of Load Factor Improvement
1. Interruptible Sales
2. Air Conditioning and other Summer Loads

Oil gas production plants include both converted low Btu water gas sets and modern hi-Btu oil-gas plants. When natural gas was first introduced into many communities, it was economical to convert existing gas making facilities to produce a substitute for natural gas. This converted capacity was useful for emergency stand-by purposes as well as for peak shaving.

Various modern processes are available for making a more or less satisfactory natural gas replacement from hydrocarbon feedstocks, but in general their costs are too high for the low volumes of peak shave gas usually required in the South. Use of converted water gas plants has been abandoned in some locations because of high stand-by costs and the difficulty of recruiting and training personnel for plants which operate only a few days per year. There are not many left in the South.

Referring to LPG plants, these contribute by far the greatest total amount of capacity for producing peak shave gas in the South. Costs of tanks required for storing liquid propane under pressure make up a large part of the fixed charges on propane-air gas plants. The amount of storage to provide for a given situation is a very important problem and depends, in general, upon the duration of cold weather periods and the ability to replenish supplies during the winter. Storage provided for stand-by purposes may or may not be considered available for peak shaving.

Costs of propane storage may be reduced by refrigeration of the liquid to lower its pressure, permitting use of lighter weight steel tanks, as has been done in Atlanta. Underground storage of propane in natural formations or man-made caverns is becoming increasingly important. Large capacity underground storage projects have been developed for costs of around $1 to $2 per bbl of propane stored, and in some cases for as low as $0.50 per bbl.

Propane or butane must be vaporized and mixed with air before it can be used as a substitute for natural gas. Plant demand costs depend upon distribution pressure requirements. Only the air for mixing needs to be pumped, which reduces compressor horsepower.

Some companies have found that installation of air injectors, when the motive power of natural gas can be utilized, has saved compressor costs. There are automatic propane-air gas plants that operate at predetermined load and pressure conditions, and are very useful for emergency stand-by or peak shaving, particularly in outlying sections of distribution systems.

Commodity costs of propane are largely its production cost at refineries or stripping plants plus transportation costs to points of utility storage. It was reported recently by the National Petroleum Council that in 1956 some 44.5 percent of the transportation of LPG was by tank truck and 41.8 percent was by railroad tank cars. Only 7.4 percent was moved via pipeline, but the use of this method is increasing rapidly. Transportation of propane by pipeline costs about 0.15 to 0.20 cents per bbl per 100 miles for substantial volumes. This method, when integrated with large terminal storage, would cost less than present rail or truck rates in many areas if it becomes available.

When propane-air gas is used for peak shaving natural gas, the amount which can be used in the sendout mixture generally is limited, because its burning characteristics are different from natural gas. In many peak shaving situations, it is necessary for proper interchangeability to produce a propane-air gas of greater heating value than the natural gas which it supplements. When cost of this extra heating value is not paid for by the utility customers, it becomes a loss. Heating value loss may be estimated and included in the commodity costs for propane-air gas when using the *Economic Point Peak Shave Formula.*

In recent years, the Hasche process for reforming propane has been installed in the South by a number of utilities for peak shaving purposes. The

EXAMPLE

LOAD DURATION TABLE

DAILY MEAN TEMPERATURE	DAYS HAVING THIS TEMP.	CUMULATIVE DAYS OF COLDER TEMP.	CUMULATIVE DEGREE DAYS COLDER TEMP.
12	1	0	0
13	0	1	1
14	2	1	2
15	3	3	5
16	0	6	11
17	4	6	17
18	3	10	27
19	3	13	40
20	4	16	56
21	2	20	76
22	3	22	98
23	4	25	123

LOAD DURATION CHART

MEAN TEMP.	DEGREE DAYS
12	53
13	52
14	51
15	50
16	49
17	48
18	47
19	46
20	45
21	44
22	43
23	42

Hasche process converts some of the propane into lighter hydrocarbons by pyrolytic cracking in a specially designed furnace. Conversion efficiency is high and little labor is required. The reformed gas has a heating value about the same as natural gas. It is more substitutable for natural gas than propane-air, therefore higher proportions of it can be used in peak shaving.

Butane also is used as feedstock and tests have indicated that natural gasoline may be reformed by the Hasche process into natural gas substitutes. These liquids can be stored in lighter weight, less costly steel vessels than propane. Their use could reduce plant investment costs and therefore demand costs if such liquids are available at an economic price.

Better interchangeability of Hasche gas with natural gas permits its production at a higher hourly load factor compared to propane-air, which reduces peak hour capacity requirements. Some savings in commodity costs can be made by not furnishing customers extra heating value gas as is sometimes necessary with propane-air.

Hasche Plants

It is interesting to note the extent of installation of Hasche process plants in the South. Included in the following list are present low Btu plants, many of which probably will be adapted to peak shaving when and if the local systems are changed over to natural gas.

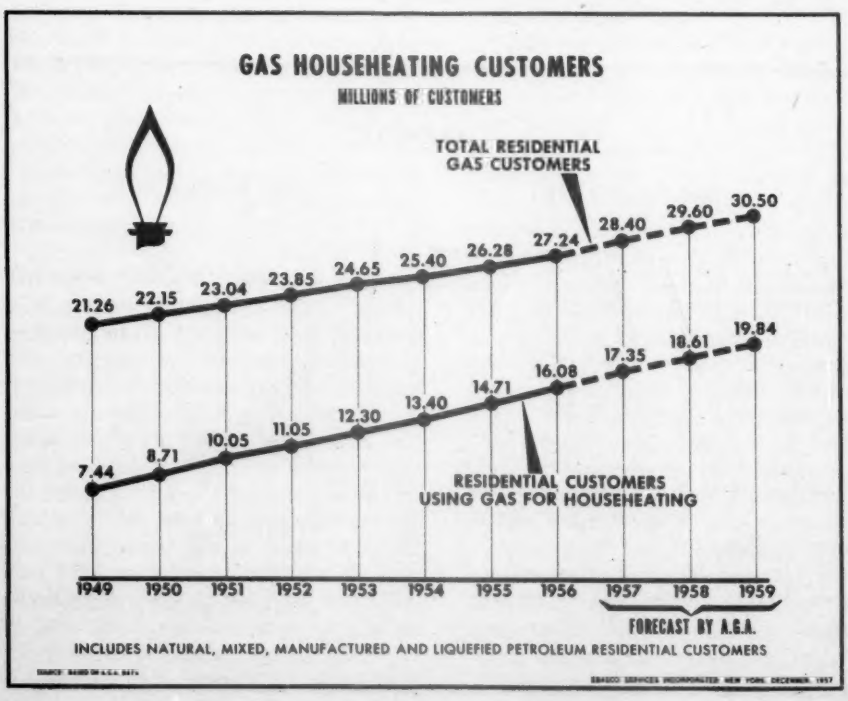
State	No. of locations	Total daily capacity of Hasche Plants in MMcf
Alabama.....	3	6.5
Florida.....	8	19.5
Georgia.....	1	2.0
North Carolina.	2	7.0
South Carolina..	1	2.0
Tennessee.....	1	1.0
Virginia.....	3	10.5
Total.....	19	48.5

Other Storage

Under "C — Natural Gas Storage," such facilities have the advantage that there are no interchangeability problems. **Low-pressure holders** are available in some plants, left over from manufactured gas days.

High-pressure containers include steel tanks and heavy wall steel pipe lengths connected in batteries, with the necessary compressors and regulating equipment. **Line pack** from a long transmission pipeline may be considered for peak shaving if it is possible to draw down the pressures over a period of several consecutive peak days.

Underground storage of natural gas in the summer for subsequent withdrawal to supply winter peaks has become increasingly important in recent years. Gas may be stored underground in a suitable porous rock structure having an impermeable dome under which the existing oil, gas, or water fluids may be replaced with stored gas. Several large load centers close tc the South now have or expect to have underground storage facilities. It may well be that suitable structures can be developed and utilized to further advantage in the South as winter loads continue to grow.



Storage of liquefied natural gas at approximately −260 F in specially designed, highly insulated steel tanks has been studied for a number of years. Proceedings of the 12th Annual Short Course in Gas Technology, sponsored by the Southern Gas Association, contains an excellent article entitled "The Economics of Liquefaction, Storage, and Transportation of Natural Gas." For peak shaving, a plant should have a long summer filling period of, say, 10 months and a 2-month winter peak delivery period. Economic feasibility of such a project would depend upon estimates of demand and commodity costs taking into consideration all the appropriate factors for a given situation.

The Comstock Liquid Methane Corporation is expecting to ship an experimental delivery of liquid natural gas to London in the near future. Results of this experiment will be watched with interest.

Under Method "D — Natural Gas Pipeline Winter Peaking Service," some sections of the country are being offered this service by pipeline suppliers in competition with other local methods of peak shaving. Generally, **winter peaking service** is made available in connection with underground storage facilities or from temporary excess pipeline capacity.

For "E — Methods of Load Factor Improvement," **interruptible gas sales and summer loads,** such as air conditioning, are well known to be of considerable importance for increasing annual load factor.

Gas House Heating

The accompanying chart indicates the magnitude of customer growth in the field of residential space heating on a national basis. By and large, it is the increase in residential gas space heating customers, together with general space heating loads, which controls in large part investment requirements and makes the peak demand upon the pipeline.

In the past few years there have been important changes in the methods of handling peak day problems of gas distribution companies. Outlined in this paper are some fundamental methods for solving peak shaving problems. In considering various methods, it must be realized, of course, that each individual situation should be studied in the light of local conditions in order to determine which supply source will provide the most economical and reliable service to your customers.

Acknowledgment

This article prepared from a presentation made at the Southern Gas Association convention, Dallas, Texas, April 1958.

* * *

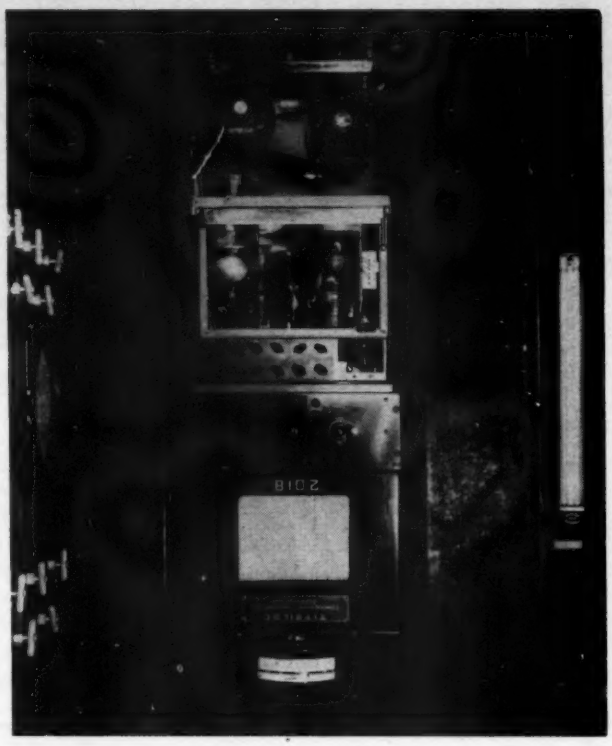


FIG. 1. Console model Titrilog installed in existing gage board. Natural gas received at each manufacturing plant is monitored by this type of instrument.

Operating Experiences with the TITRILOG

S. W. Greenwood,
Philadelphia Gas Works,
Division of United Gas Improvement Company
Philadelphia, Pennsylvania

TO A GAS DISTRIBUTION COMPANY, it is of the utmost importance that odor level be fairly constant, and simultaneously, of a sufficient concentration for safe operation. On the other hand, over-odorization can result in excessive "nuisance" leak complaints due to the negligible escape of gas during the ignition period of burners on appliances. For this reason, The Philadelphia Gas Works now monitors the odorant level on a continuous basis of the gas it distributes.

PGW receives its gas from two suppliers — Texas Eastern Transmission Corporation and Transcontinental Gas Pipe Line Corporation. At PGW's Station "A" plant, natural gas is received from only one of the suppliers; at Station "B" plant, it is received from both suppliers through a common line within the city limits, and is a mixture of gas from both companies.

Because natural gas is substantially odorless, PGW considers it necessary to odorize this gas so that its presence will be readily detected and recognized.

Both suppliers add odorant to the gas delivered to PGW, with Texas Eastern adding odorant at Eagle, Pennsylvania, and Transco adding odorant at Malvern, Pennsylvania. Both locations are approximately 30 miles west of Philadelphia.

Necessity of Instrumentation

Prior to 1954, PGW could not determine with any degree of certainty whether the odor level of the natural gas received was high, low, or at the desired level. An instrument to record the odor level of the natural gas was installed to help answer this problem.

Titrilog Installed

In 1954, a console type *Titrilog* was installed at the Station "B" manufacturing plant. Installation was on a rental basis for a trial period. Results obtained from the use of the instrument were very satisfactory. Only a normal amount of maintenance was required. Since natural gas received at this plant (and monitored by the *Titrilog*), was a mixture of gas from two suppliers, this instrument and two additional instruments were purchased. Two additional instruments of the portable type (Fig. 2) were installed at each of the suppliers metering stations.

In the event of either a high or low odor level at the plant, it can now be determined by inspection of the *Titrilog* charts at the metering stations which supplier is at fault. Ability to determine this fact accurately is a decided advantage in that it is unnecessary to ask each supplier to check his odorization equipment.

An additional *Titrilog* was later installed at the Station "A" plant to monitor the odor level of the natural gas on this supply line. This was necessary because the supplier odorizes this line with equipment separate and independent of the line supplying Station "B."

Readings from the charts are easily converted into pounds of odorant per Mcf by application of the appropriate instrument factor. This factor is determined by calibration with a gas of known sulfur content.

If the odor level of the natural gas received is above the limit as prescribed by the "odorization committee" of PGW, the responsible supplier is notified. If the odor level is below the prescribed limit, the responsible supplier is also notified. In addition, in the latter case, additional odorant is injected into the sendout gas of the plant in question, to make up the deficiency, until the odor level of the natural gas returns to within the prescribed limits.

Operation

The *Titrilog* is an instrument to record concentration of sulfur compounds in a gas stream. Since the sulfur content of odorized gas is in proportion to the odorant concentration, it is possible to record the amount of odorant in the gas with the *Titrilog*. Continuous and nearly instantaneous readings of odor concentration are a valuable feature of the instrument. Odorizing equipment failures are soon apparent. The unit indicates when faulty conditions have been corrected, and produces a complete, permanent, timed record of all variations.

The *Titrilog* is not used to monitor PGW sendout gas. Manufactured gas contains illuminants in concentrations sufficiently great to interfere with the sulfur determination.

Two models of the *Titrilog* are used by PGW. One is the standard stationary model, capable of selective recordings. All parts are installed in a floor mounted case in this model, which can be equipped with an alarm actuator to signal at a predetermined maximum concentration and can be modified for multiple point sampling.

The other is a portable model for field or laboratory work. This doesn't mean, however, that it cannot be used as a permanent installation. This model consists of three units: The *Titrilog*, a

FIG. 2. **Portable Titrilog**, filter box, and record. This model is located at the metering stations of the suppliers.

recorder, and a filter box. Each of the units is equipped with handles for ease of transporting.

Each model is composed of several major assemblies and sub-assemblies. Their functions and some of the maintenance and trouble-shooting problems handled by PGW will be discussed.

Titration Cell

The titration cell is made of pyrex with ground joints. The greatest difficulty has been to disassemble the cell without breakage. The lubricant, obtained from the manufacturer of the instrument, makes a good vacuum-tight joint that is of the utmost importance; it has, however, a tendency to harden after a period of time.

PGW's practice is to disassemble the cell prior to each calibration and remove the old lubricant. In relubricating, a sufficient amount is used to insure coverage of all necessary surfaces.

Cell design includes a charcoal filter between the inner and outer compartments and a method for circulating electrolyte continuously between the two compartments, so that reaction products produced in the titration will not build up and cause trouble. This circulation is achieved by using a spillover tube. Electrolyte is carried up by the bubbles from the gas flow so that the spillover tube is filled at all times.

Excessive noise level or full scale reading of the recorder pen can be caused by partial or complete stoppage of the orifice located at the bottom of the tube. In most cases this stoppage is caused by charcoal from the filter. It is sometimes necessary to carry the electrolyte level in the cell slightly higher than normal so that the bubbles created by the gas flow will rise higher in the inner compartment, thus keeping the tube completely filled with liquid.

A yellowing of the cell electrolyte is caused by a reversal of current through the generating electrodes. This allows bromine to be generated at the outer generator electrode. This trouble may be caused by failure of the reference battery or improper setting of the zero adjustment rheostat. PGW's practice is to replace the reference battery as soon as the rheostat scale indicates 640. It is easier and much more economical to change the battery more often than to perform complete servicing of the titration cell. Yellow cell electrolyte should, of course, be immediately replaced as well as the cell charcoal.

Gas System

The gas sample line should be of aluminum tubing or stainless steel pipe. Preference is given, in PGW's installations, to aluminum tubing, which is less expensive and more easily installed than pipe. Obviously, low chart readings can be caused by low odor level; low readings can also be caused by failure of certain parts of the instrument itself.

Correctness of chart readings depends, to a great extent, on the sample orifice being able to deliver the proper amount of gas to the titration cell. This amount of gas is determined at the time of the calibration. It is most important that the sample orifice be properly positioned in the orifice holder. Foreign matter in the gas stream may partially or completely restrict the flow. The installation of a small filter in the gas sample line will reduce this trouble materially.

In the cabinet model, a check orifice is supplied for periodic checking of the flow. In the portable model, an approximate check can be made by diverting the gas flow through the flowrator by use of the sensitivity needle valve and setting the flow as shown by the last calibration. It is necessary to close the sample orifice during this procedure. Any increase in the net titration would indicate a need for cleaning the orifice. Liquid in the pressure regulator should be maintained at the correct height so the sample orifice delivers a constant and sufficient supply of gas to the cell.

Amplifier

The amplifier is that unit on which the various controls are mounted and is located in the center of the instrument on the console model. Located on the front panel are the power switch, fuses, pilot light, zero adjusting potentiometer and the filter selector switch. To the rear of the front panel are the sensitivity and "test" switches.

The sensitivity switch is used as a means of extending the range of the instrument. The "test" switch is a means of checking the amplifier for faulty operation. With the sensitivity switch in the high position and the "test" switch turned to **TEST** the reading should be at least 40 scale divisions. Any reading lower than 40 can usually be increased by the replacement of faulty tubes or converters.

Programming

The console model *Titrilog* can be set to run through a three-hour cycle of twelve 15 minute periods. A microswitch, actuated by the chart drive clock in the recorder, provides a signal every 15 minutes that actuates a 12-point stepping switch. A series of 12 program switches are controlled in turn, by the stepping switch. These program switches operate the solenoid valves to admit gas to the cell either directly or through filters as desired. Any sequence desired may be operated on an automatic repetitive cycle. Manual selection is also possible by use of the filter selector switch.

PGW uses a cycle of 45 minutes on the gas sample and 15 minutes at the zero level. The *Titrilogs* located in the production plants are read each hour. With the above cycle, any deviation in the zero level can be seen and an immediate correction in the net titration level is possbile.

The portable *Titrilog* filter box can also be programmed, however, the length of the cycle totals one hour in 15-minute periods. The portable *Titrilogs* at the suppliers' metering stations are read at four-hour intervals, except during high or low odor level periods when the observations are made more frequently.

By modifying the manifold, the programming system can be made to sample as many as four different sample sources, if filtration is not desired.

As previously mentioned, only one company supplies natural gas to the Station "A" manufacturing plant. In the near future, natural gas will be received from both suppliers at this location. Delivery lines will be separate and in close promixity to the *Titrilog* location. The intent is to record separately the odor level of both natural gas streams by slight modification of the instrument. Sequence and duration of the recordings will be determined later.

Calibration

The four *Titrilogs* operated by the

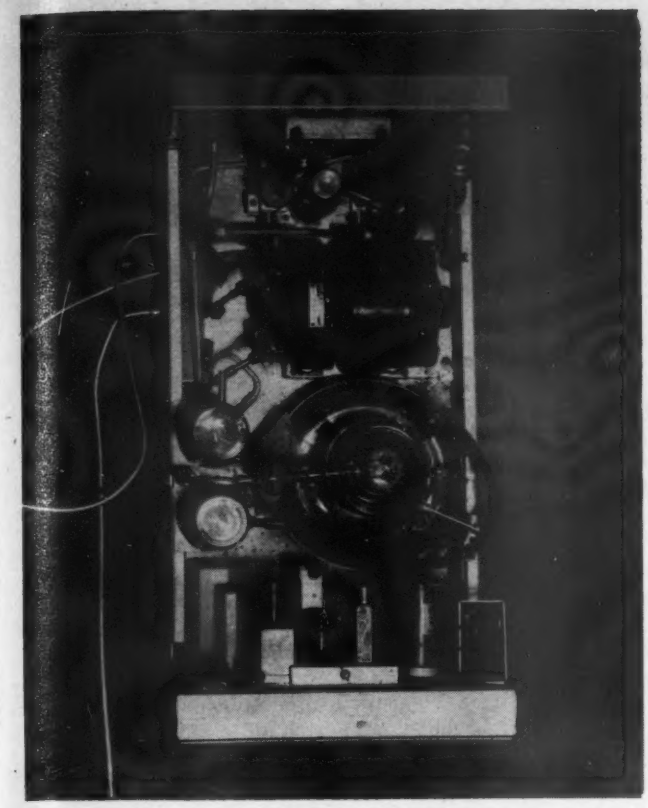


FIG. 3. **Top view of portable Titrilog showing location of parts.**

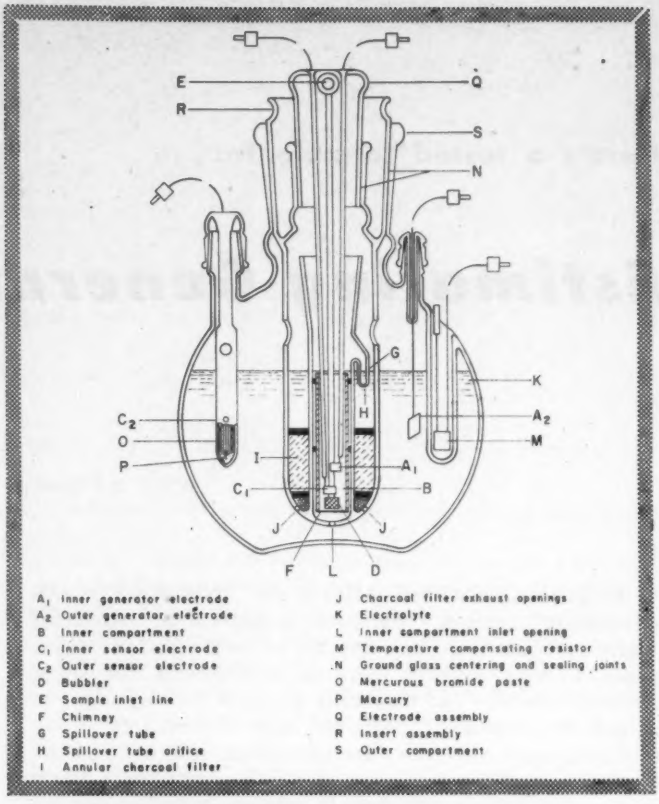


FIG. 4. **Details of the Titrilog titration cell.**

PGW are calibrated periodically. A service contract with the manufacturer provides for calibration and calculation of cell and instrument factors at two-month intervals for each instrument. A day or two prior to calibration, each *Titrilog* is carefully checked and any necessary maintenance is performed.

The operator makes careful inspection of the various points as outlined below:

A. Sample flow should be cleaned with the orifice cleaner provided. Pump orifice should also be cleaned. Frequency of cleaning will depend on how much dust or foreign matter enters with the sample.

B. Liquid level of saturator bottles in the console model, and the titration cell in both models should be brought to the proper height.

C. Inspect spillover tube for correct operation as mentioned previously.

D. Thoroughly clean cell bubbler with acetone followed by a rinse with distilled water.

E. Clean the fritted dust filters before the sample orifice and titration cell.

F. Replace tygon tubing that is dirty or hardened by acid.

G. Examine and change pump and air charcoal filters if necessary.

Doing this work in advance eliminates any unnecessary delays during the calibration.

This calibration employs use of a gas of known sulfur concentration. This sample is prepared with methane and a metered volume of sulfur compound, either hydrogen sulfide or butyl mercaptan, depending upon the instrument factor desired. Sample is contained in a stainless steel tank equipped with stainless steel fittings.

Preventive and routine maintenance tend to insure the instruments' proper functioning. Obviously the record obtained is of vital importance and consequently it should be as accurate as possible. In order to obtain the desired reliable and accurate record, the operational and maintenance program should be performed with care and regularity.

Generally speaking, good housekeeping on all types of equipment pays dividends in increased reliability and trouble free operation. The downtime on the four *Titrilogs* operating in the Philadelphia Gas Works averages less than one percent per instrument.

Conclusion

PGW's Customer Service Department states that, prior to installation of the *Titrilogs,* it was not unusual to receive several hundred additional reported leaks from customers during a short period of time due to over-odorization of the natural gas by a supplier.

In the operation of domestic gas appliances, there is a small amount of gas liberated during the period between the turning on of the valve and the lighting of the burner from the pilot. It can readily be seen that, if the gas is too heavily odorized, the customer will believe that a leak exists.

The Customer Service Department further reports that, since the installation of the *Titrilogs,* nuisance leak complaints attributed to the over-odorization of the natural gas by either supplier have been almost completely eliminated.

There have been instances when the odor level of the natural gas was inadequate. One particular case was caused by power failure at the supplier's odorization station. The low odor level was recorded by the *Titrilog* on the affected line, and the supplier, upon notification of the low readings, promptly made the necessary repairs.

The cooperation received from both suppliers, when notified of odor deviation from the normal level, has been excellent. Restoration of odorization to the proper level has been accomplished with a minimum of delay.

Acknowledgment

This article prepared from a presentation made at the AGA Operating Section Conference, New York City, May 1958.

References

1. D. McA. Mason, "The Titrilog: Its Application to Odorization Problems." 1957 AGA Chemical, Engineering and Manufactured Gas Production Conference, Bal Harbour, Florida.
2. B. H. Loper, "Odorization from the Customers Service Department Viewpoint." 1956 AGA Chemical, Engineering and Manufactured Gas Production Conference, Philadelphia, Pennsylvania.
3. H. Landsberg and E. E. Escher, "Potentiometric Instrument for Sulphur Determination." *Industrial and Engineering Chemistry,* Volume 46, July 1954.

★ ★ ★

Here's a tested formula for . . .

Estimating General Service Revenues

Donald C. Neill,
Rate Analyst
Southern Counties Gas Company
Los Angeles, California

TOP MANAGEMENT MUST BE INFORMED ON prospective earnings. Therefore, a method of estimating future revenues is a basic tool for all well managed enterprises. In each industry there are methods of calculating revenue estimates and the utility group is no exception. In certain respects it is relatively easy to estimate utility revenues, since most rates for service are subject to public regulation and are fixed at a particular level for a fairly long period of time. In contrast, other industry groups are more subject to competitive market conditions which usually require price changes at much more frequent intervals.

In some utilities, revenue estimates originate in the rate department. This department is responsible for keeping management properly informed of the current level of earnings in relation to the allowable net earnings prescribed by regulatory bodies, and for designing rates which will yield the revenue required to produce an adequate earnings level.

Other utilities will rely on the accounting department to produce revenue estimates. Accountants are primarily interested in revenue estimates because revenue is the source of funds for meeting expenses. Close control of income requires that all revenue be properly billed and collected.

Regardless of the fact that the two departments may have different basic needs for revenue estimates, the estimate should be a single responsibility. Since rate engineers generally design the rates that produce the revenue and since they are more familiar with the peculiarities of customer usage that may cause variation in revenue, it would appear that this group can reasonably be charged with the responsibility for revenue estimates in many situations.

General Service Revenues

In the gas industry, the *general service revenue* category (residential and small commercial) is generally the largest component of a distribution utility's total income. Therefore, it is very important that the basis for calculating this revenue estimate be accurate. Experience has shown that the use of a straight-line formula can produce results that, when based upon the assumed average use per meter and estimated meters, are extremely close to the actual revenue that is received when the assumed conditions are experienced.

The formula approach has as its objective an estimate of the average revenue per general service meter for a given month. This estimate multiplied by the number of customers will give the total general service revenue which can be expected.

Fig. 1 illustrates the relationship between a rate curve based upon a typical rate schedule as applied to an individual bill and a curve produced by the formula that represents the average rate relationship of all the customers. The use of an average of this type eliminates the effect of the considerable variation in individual customer usage.

The typical schedule has a minimum charge, including some usage, plus block rates that decrease as higher use is experienced. This relationship is represented by Line X (the curve is exaggerated to show the comparison). The distance OX represents the minimum charge, the "plateau" in the curve, before the upward slope begins, represents the volume of gas covered by the minimum charge. The height of the curve at any point indicates the cost of the volume of gas represented.

Line Y illustrates the application of the formula. Notice that, for certain consumption levels, the formula will yield a higher revenue per meter than would be obtained if the rate schedule were applied to the average use. At other consumption levels the opposite effect results, but in actual practice these variations are small.

Methods of Calculation

Although it is desirable to base the calculation of the formula used to make the estimate upon a series of data with fairly wide usage characteristics covering five or six months, in which case the so-called "least-squares" method of calculation, illustrated in Table 1, would be used, a short-cut method for calculating it requires but two months.

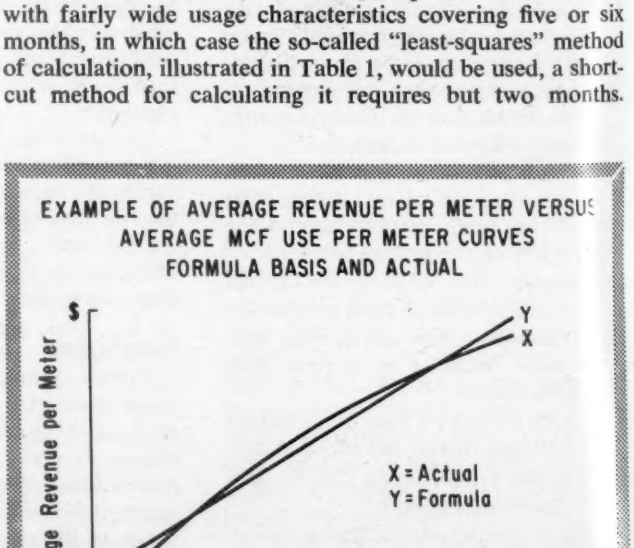


TABLE 1. Example of Calculation of Revenue Formula.

	Actual				Revenue per Meter	
	Revenue/Meter X_1	Mcf/Meter X_2	X_1X_2	X_2^2	Per Formula	Actual Less Formula
1955 November	$ 6.278	7.653	48.045534	58.568409	$ 6.278	$ —
December	8.807	11.518	101.439026	132.664324	8.810	(.003)
1956 January	9.889	13.152	130.060128	172.975104	9.881	.008
February	9.847	13.114	129.133558	171.976996	9.856	(.009)
March	9.002	11.806	106.277612	139.381636	8.999	.003
April	7.186	9.038	64.947068	81.685444	7.185	.001
Σ	51.009	66.281	579.902926	757.251913	$51.009	—
Σ ÷ N (N = 6)	$ 8.50150	11.04683				
Σ × N			3479.417556	4543.511478		
ΣX × ΣX			3380.927529	4393.170961		
Difference			98.490027	150.340517		
Difference ÷ N^2			2.735834	4.176125		

b = 2.735834 ÷ 4.176125 = $.655113
a = 8.50150 — (11.04683 ÷ .655113) = 8.50150 — 7.236922 = $1.264578

These two months should also reflect a fairly wide differential in usage, and must be free of any "book" adjustments resulting from correcting entries related to prior recorded data. **In other words, the sales, revenue, and meter data must be consistently related.**

The following is an example of the short-cut calculation method. Suppose the given data are actual results for the months of November and the following February, two months in which the same rates were in effect. These data represent the combined experience obtained from all areas on the system and reflect the application of several different rate schedules. Each schedule, however, has the same blocking.

	Meters	Mcf Sales	Revenue
November	119,797	916,862	$ 752,125.71
February	125,322	1,643,431	$1,234,076.02

From this information the following calculations are made:

	Revenue per Meter	Use per Meter
November	$6.278	7.653
February	$9.847	13.114

The formula used to estimate the average monthly bill per meter is:

a + (b x Mcf — use per meter)

The "a" factor, represented on the chart by the distance OX, is the average fixed charge per meter. It does not vary with consumption, and is calculated by deducting from the average revenue per meter for either month the cost of gas sold during that month. "Cost of gas" for this purpose, is calculated by pricing the volume sold, per meter, by the incremental rate, or "b" factor. The "b" factor is calculated by dividing the difference in revenue per meter in the two months by the difference in use per meter for the two months. The present example is solved thus:

	Revenue per Meter	Use per Meter
February	$9.847	13.114
November	6.278	7.653
Difference	$3.569	5.461

b = $3.569 ÷ 5.461 = $.6535
a = $9.847 — (13.114 x $.6535) = $1.277

Putting Formula to Work

In actuality, the amount of money in the "a" factor may be the same or more or less than any minimum charge in a rate schedule depending upon the amount of gas offered under the minimum charge, if any, and the average use characteristics of customers with respect to the various commodity blocks in the schedule. As an example in using the formula, suppose we are estimating revenue for the month of April a year later. The use per meter is estimated at 8 Mcf and the number of meters at 144,500. By using the formula, the revenue under these conditions would then be:

Revenue per meter = $1.277 + ($.6535 × 8) = $6.505
Total est. revenue = $6.505 × 144,500 = $939,972.50

When April results are determined we find the following:

Revenue	$960,548.14
Mcf sales	1,187,226
Meters	144,622
Revenue per meter	$6.642
Mcf per meter	8.209

It is apparent that two factors caused our revenue estimate to be lower than the actual, the use per meter and number of meters were both low. As a check on the accuracy of the formula, however, we shall apply the formula to the actual figures:

Revenue per meter = $1.277 + ($.6535 x 8.209) =	$6.642
Total revenue = $6.642 x 144,622 =	$960,579.32
Actual revenue =	960,548.14
Difference	$ 31.18

This difference is negligible and establishes the validity of the formula approach to estimating.

How to Use Formula

Rate department personnel can use this "formula method" to advantage in preparing estimates of future revenue under present rates for rate case presentation or for budgetary purposes. It is much simpler to use than the standard approach of plotting charts of the experienced use per meter against the revenue per meter.

A further application of the formula in rate case work is in the design of rates and calculating the revenues to be derived therefrom. Of course, it is necessary to have available the average use characteristics by rate block from a bill analysis. Once this is done, the new rate may be applied for two typical months and the formula subsequently derived, as outlined above, under the short-cut method.

Accounting department and billing personnel can also use this type of formula for checking monthly general service revenue postings. It is particularly valuable at that point in accounting just prior to "closing the books" for the month. Obviously, if an error is made in one month's figures and subsequently discovered, it would be corrected during the following month. This procedure has the disadvantage of making two months' reported results in error, even though technically the error has been corrected.

In order to minimize the chance of error, it is suggested

that, for accounting purposes, the check of revenue billing be accomplished as soon as data are available and that the check be made on a per meter basis.

For example, using the above results for April, the comparison on a per meter basis is:

$1.277 + ($.6535 x 8.209) =	$6.642
Actual revenue per meter =	$6.642
Difference	0

Checking for Errors

Normally, a variation of less than two cents per meter can be experienced without concern. If the difference is much greater, an error either in billing, meter count or the Mcf sales tally has most likely occurred. Individual company methods in revenue accounting procedures will probably indicate in which of these areas the error can be found.

To illustrate this point let us take an example. Suppose that the results for April were understated by 10,000 Mcf in sales (less than 1 percent), due to a clerical error, and a total of 1,177,226 Mcf was reported instead of 1,187,226. The use per customer would then have shown 8.140 Mcf. Using the formula for checking the reported revenue of $960,-548.14, we would have had:

Expected revenue per meter = $1.277 + ($.6535 x 8.140) =	$6.596
Reported revenue per meter =	$6.642
Difference	$ .046

Since this difference exceeds a reasonable tolerance of two cents per meter, an error would be suspected. It can readily be seen that the formula is extremely sensitive in picking up discrepancies in billing procedure. If the accounting records were closed before the error in the April figures was discovered, it would probably be corrected in May. If this were done, then May results would have to be adjusted prior to making a similar check on the results for that month since sales would be overstated by the 10,000 Mcf April deficiency. Obviously, it is desirable to correct such errors prior to closing the books for the month. The formula is not guaranteed to locate all posting errors; however, it is of great assistance.

Periodic Recalculations Desirable

A recalculation of the formula should be made periodically so as to get the best possible "fit," i.e., the smallest difference or deviation between revenue per meter as reported and as calculated by the formula. For instance, when usage characteristics change on a mass basis and customers tend to use more gas in the higher rate blocks, the formula may require a revision.

Rate changes will require a formula revision. If a uniform increase in rates is applied to all rate blocks, on all schedules, and the minimum charge is left undisturbed, the formula need only have the "b" factor increased by the amount of the rate block increase. If the minimum charge is increased uniformly then this increase may be added to the "a" factor as a close approximation of the effect. Obviously, a new formula should be developed as soon as there has been several months' actual experience under the new rates.

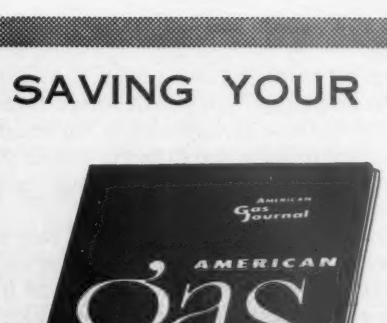
Some difficulty will be had with the formula if a company has frequent and relatively wide fluctuations in the heating value of gas served and if rates vary accordingly. The proportion of total sales subject to this type of rate change will influence the validity of the formula. Transfers of customers from one rate level to another may also invalidate a formula, dependent upon the number of customers involved.

Formula Is Flexible

This type of formula is extremely flexible and can be derived not only for a company as a whole, but also for separate operating divisions or areas, notwithstanding the fact that one or more rate schedules may be applicable in any one area. Each area, of course, would have its own formula based upon its own average Mcf use per meter and revenue per meter.

It is also possible to develop a formula for other classes of service, such as the firm industrial category. In fact, this method of estimating or checking revenues can be utilized by other types of utilities as long as they employ similar forms of rate schedules. The reliability of such a formula will depend to a great extent upon the number of customers in these classes which have fairly uniform load characteristics. * * *

SAVING YOUR FUNDAMENTALS CHAPTERS?



Keep them in good condition and in convenient form for quick reference with this attractive, durable imitation leather ring binder... designed especially for filing and protecting Fundamentals chapters as they appear in each issue of AMERICAN GAS JOURNAL. Yours free, with your new or renewal subscription to AGJ, only $3. If you do not have this handy ring binder, order today!

MAKE YOUR FUNDAMENTALS COMPLETE . . .

If you have just begun saving the Fundamentals chapters, you will want this reprint of the first section, "Glossary of Gas Industry Terms," a 44-page booklet available with a new or renewal subscription to AMERICAN GAS JOURNAL, for only $3. "Glossary" contains complete information on all gas industry technical terms.

Address your orders to Dept. D-7

American Gas Journal | P. O. Box 1589 Dallas 21, Texas

About this article:

This article presents the results of a study of the performance of propane-enriched carrier gases in the 1000 to 1500 Btu per std cu ft range when substituted for high-methane natural gas on a group of seven critical burners mounted in the open, a group of selected contemporary range and hot water heater burners mounted in the open, and a group of 13 critical and contemporary appliances. The critical burners, and the appliances, had also been employed in a similar study of high-Btu oil gas substitutability for natural gases. Gases simulating various catalytic reforming products, process hydrogen of different purities, and air were used as carrier gases.

In the burner tests, yellow-tipping, transient flashback and blow-off tendencies were determined at three primary air shutter settings corresponding to moderately hard (+2 AGA Code), normal (0 AGA Code) and moderately soft (—2 AGA Code) flame adjustments on high-methane natural gas. The maximum percent of propane-enriched carrier gas in the mixture of substitute gas and base gas exhibiting satisfactory combustion performance on the critical burners was defined as the substitutability value. The appliance tests were conducted on six representative gas mixtures found substitutable on the critical burners. The tests were made to determine if additional limitations on substitutability were imposed by CO generation and ignition delay, as well as flame appearance, for burners mounted in the appliances for which they were designed. Observations on the performance of the contemporary appliance burners are also reported. Critical burner test results are presented in a graphic and tabular form to define the differences in combustion performance between propane-air gases and propane-enriched carrier gases of various hydrogen content at equal relative heat inputs and at equal heating values.

Substitutability of Propane-Enriched Carrier Gases for Natural Gas

R. T. Ellington, E. F. Searight, and H. R. Linden
Institute of Gas Technology
Chicago, Illinois

MANY DISTRIBUTION COMPANIES have found it necessary to supplement the available supplies of natural gas, including that stored near the point of consumption, with other sources of high-Btu gas during periods of peak demand to enable them to serve the largest number of consumers at minimum cost. Complete substitution of natural gas is generally considered only under emergency conditions, since most supplemental gases do not have acceptable burning characteristics on appliances adjusted on the base gas.

A number of processes are used for converting fluid fossil fuels into high-Btu gas. High fixed-cost, low feedstock cost processes, such as production of high-Btu-oil gas from residual oils, may be used through a considerable portion of the year.[2] Low fixed-cost, high feedstock cost processes, such as those utilizing LPG, are generally used only during a short period of the year.[1,2]

Most widely used method for meeting extreme peak demands is production of LPG-air mixtures. Partial combustion products of LPG[4,7] and gases produced by catalytic reforming of hydrocarbons[5] are also used commercially as carrier gases for cold-enriching with LPG. In addition, process hydrogen has been suggested as a carrier gas, which would permit cold enrichment to a 1000 Btu per std cu ft (standard cubic foot at 60 F, 30-in. mercury, saturated) gas of only 0.6 specific gravity (air = 1).[6] Even when the relatively high specific gravities of propane-carrier gas mixtures are compensated by

TABLE 1. Analyses of Carrier Gases Simulating Reformed Gases (Nominal).

Gas No.	1	3*	4	5**	6	10	11	12	14	17	25	26	27
Composition, mole %													
H_2	75.0	90.0	49.6	72.4	68.4	58.8	66.5	46.5	69.7	68.9	69.6	69.2	68.0
CO	25.0	1.0	19.6	0.6	22.2	23.9	18.8	26.6	19.5	25.9	30.0	22.0	32.0
CH_4	—	5.0	6.4	6.9	6.0	2.2	1.9	0.5	1.0	—	—	—	—
CO_2	—	2.0	8.1	2.9	1.5	4.6	8.0	0.4	8.4	—	—	8.2	—
N_2	—	2.0	16.3	17.2	1.9	10.5	4.8	26.0	1.4	5.2	0.4	0.6	—
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Heating Value, Btu/SCF	318	340	284	302	348	285	290	237	294	302	317	290	318
Specific Gravity, (Air = 1)	0.29	0.15	0.54	0.31	0.34	0.46	0.41	0.55	0.39	0.35	0.34	0.39	0.36

*Shifted and CO_2 removed (process hydrogen)
**Shifted

enrichment to higher heating values to maintain an acceptable level of heat input, it has been found that combustion characteristics differ substantially from those of the base natural gas.

The operating engineer, then, needs guides for process selection, process control, and sendout mixture control to permit him to meet his loads with optimum economy. Although considerably more comprehensive studies of interchangeability of LPG-carrier gas mixtures with natural gases have been made,[1, 10] it appeared desirable to apply, to typical propane-carrier gas systems, the approach employed by the Institute of Gas Technology in its study of high-Btu oil gas substitutability for natural gases.[8, 9]

Information in this article was developed for this purpose as part of the research activities of the Institute of Gas Technology, supported with funds provided by its members and contributors.

Experimental Methods

Combustion performance of propane-enriched gases, simulating the composition of various types of low-Btu gases produced by catalytic reforming of hydrocarbons, propane-air gases, and propane-hydrogen gases on selected burners and appliances adjusted on a high-methane natural gas was observed to determine the influence of substitute gas compositions on yellow-tipping, flashback, and blow-off behavior, and on CO generation and ignition delay.

Experimental methods used were similar to those employed in a study of high-Btu oil gas substitutability for natural gases.[8, 9] Substitute gases were mixed with the base gas in varying proportions, and the combustion performance was observed at moderately hard (+ 2 AGA Code), normal (0 AGA Code) and moderately soft (−2 AGA Code) adjustments on the base gas.[2]

TABLE 2. Test Gas Analyses.

Gas No.	Base Gas for test gases 1–6	Base Gas for test gases 10–29	1	2	3	4	5	6	10	11	12
Composition, mole %											
N_2	0.6	1.7	—	30.4	0.9	9.7	10.4	2.2	7.3	3.7	16.9
CO_2	0.6	0.1	0.2	—	1.4	4.2	1.4	1.1	3.2	5.5	0.2
CO	—	—	14.9	—	—	9.3	—	15.8	16.6	12.9	16.9
H_2	—	—	47.8	—	63.5	31.2	50.5	48.1	40.7	45.5	29.5
CH_4	94.0	96.6	—	—	3.6	7.2	4.7	3.8	1.5	1.3	0.3
C_2H_6	3.3	1.6	—	—	1.1	1.2	0.6	0.4	2.0	2.2	2.1
C_3H_8	0.8	—	37.1	61.6	28.1	35.9	32.4	27.7	24.7	24.7	30.3
C_4H_{10}	0.7	—	—	—	—	—	—	0.3	0.3	0.2	0.2
C_2H_4	—	—	—	—	1.4	1.3	—	0.2	0.3	0.8	0.1
C_3H_6	—	—	—	—	—	—	—	0.1	2.9	2.9	3.4
C_4H_8	—	—	—	—	—	—	—	0.1	—	—	—
C_2H_2	—	—	—	—	—	—	—	—	—	—	—
C_4H_6	—	—	—	—	—	—	—	0.2	0.3	0.3	—
Benzene	—	—	—	—	—	—	—	—	0.2	—	0.1
Toluene	—	—	—	—	—	—	—	—	—	—	—
O_2	—	—	—	8.0	—	—	—	—	—	—	—
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Heating Value, Btu/SCF	1040	993	1133	1528	1027	1132	1029	971	968	960	1050
Specific Gravity (Air = 1)	0.605	0.570	0.778	1.326	0.595	0.942	0.730	0.713	0.789	0.762	0.914
Relative Heat Input, %	100.0	100.0	95.4	98.4	98.8	86.6	89.3	85.2	82.8	83.7	84.0

Gas No.	14	17	19	20	24	25	26	27	28	29
Composition, mole %										
N_2	2.4	4.3	44.6	40.8	31.9	2.5	—	—	—	5.4
CO_2	5.2	—	0.3	—	—	0.1	4.2	—	—	—
CO	10.8	17.5	—	—	—	14.7	11.4	18.5	—	—
H_2	36.4	46.6	1.2	—	5.0	40.2	35.6	39.0	68.4	61.4
CH_4	4.8	—	2.8	0.7	0.5	0.8	3.2	—	0.4	0.4
C_2H_6	2.9	1.6	1.9	1.2	3.1	0.7	0.6	—	0.2	0.2
C_3H_8	31.2	27.1	31.7	40.9	45.7	36.8	39.3	42.5	30.9	32.5
C_4H_{10}	0.1	—	0.3	0.1	0.5	0.3	0.5	—	0.1	0.1
C_2H_4	1.8	—	1.4	0.6	2.6	0.2	1.8	—	—	—
C_3H_6	3.5	2.8	3.7	3.8	4.8	3.5	3.3	—	—	—
C_4H_8	0.1	—	—	—	—	—	0.1	—	—	—
C_2H_2	0.1	—	—	—	—	—	—	—	—	—
C_4H_6	0.1	—	0.4	0.8	—	—	—	—	—	—
Benzene	0.5	0.1	0.1	0.1	0.2	0.2	—	—	—	—
Toluene	0.1	—	—	—	—	—	—	—	—	—
O_2	—	—	11.6	11.0	5.7	—	—	—	—	—
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Heating Value, Btu/SCF	1170	1018	1008	1192	1413	1196	1290	1258	1011	997
Specific Gravity, (Air = 1)	0.855	0.701	1.180	1.230	1.293	0.827	0.921	0.856	0.546	0.593
Relative Heat Input, %	96.2	92.3	70.4	81.6	94.5	99.8	102.2	103.3	103.9	98.5

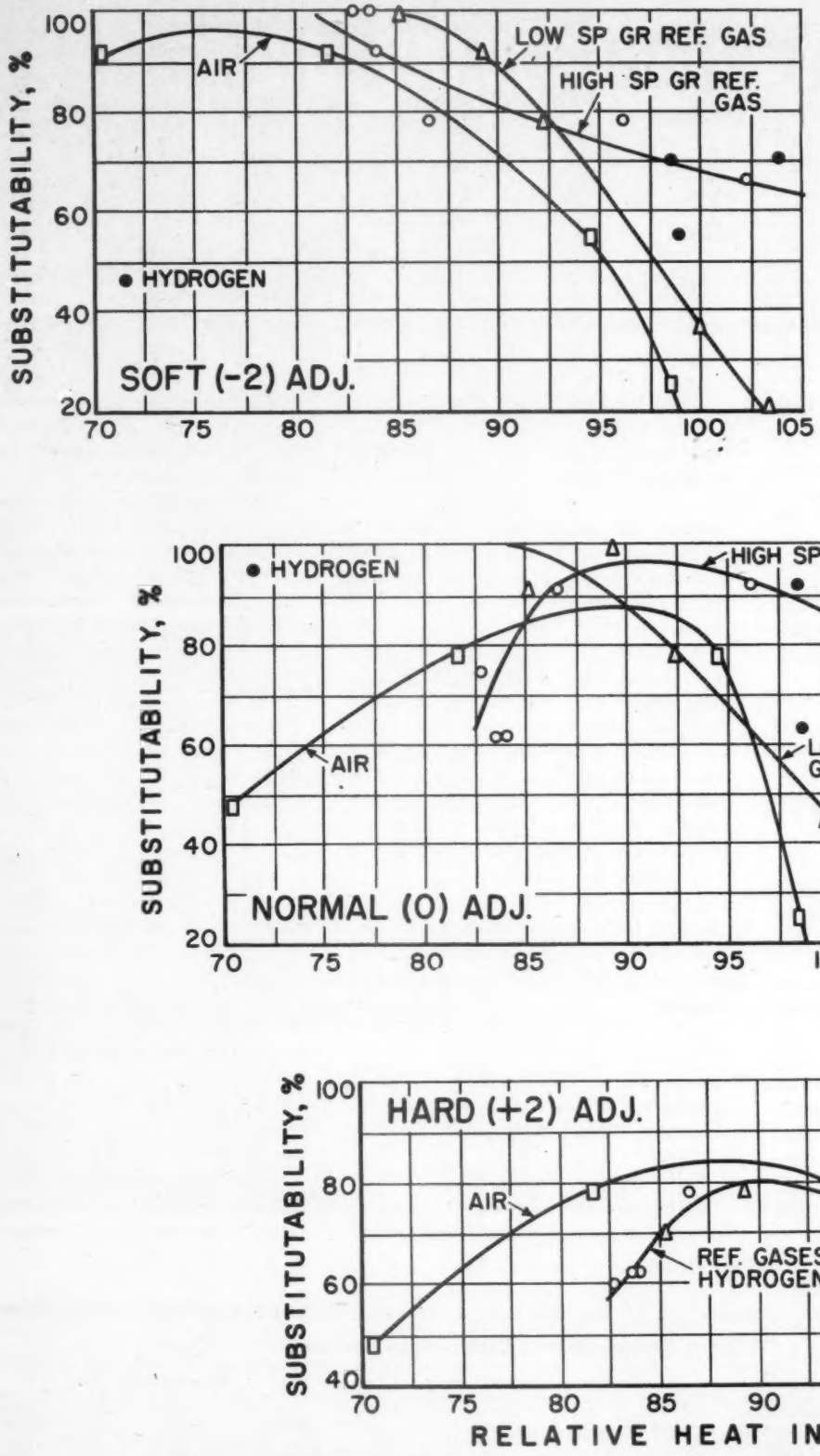


FIG. 1. **Substitutability** of propane-enriched carrier gases for high-methane natural gas on critical burners is shown for each of four types of gas used — low specific gravity (0.29 to 0.34) reformed; high specific gravity (0.39 to 0.55) reformed; air, and hydrogen. Data was obtained with five critical burners mounted in the open (see Table 5) and is plotted against the heat input relative to that of the base gas.

TABLE 3. Characteristics of Critical Burners.

Burner	Port size	Port shape	Number of ports	Port area sq in.	Rated input MBtu/hr	Port loading MBtu/hr-sq in.	High-methane natural gas adjustment Primary aeration, %*		
							−2	0	+2
Refrigerator A_1	15/64″ x 10/64″	triang.	8	0.147	2.5	17.0	—	69	—
Refrigerator A_2	3/16″ x 1/8″	triang.	8	0.094	2.2	23.4	66	— (−3 setting)	—
Oven B	31 std	circ.	91						
	40 std	circ.	4	1.090	24.0	22.0	41	47	58
	1/32″ x 1″	rect. slot	1						
Top C	36 std	circ.	42	0.560	9.0	16.1	60	71	85
	48 std	circ.	41						
Giant top D	32 std	circ.	50	0.753	12.0	15.9	59	70	87
	48 std	circ.	49						
Broiler E	38 std	circ.	105	0.850	14.0	16.5	28	43	—
Giant top F	0.101″ x 0.188″	rect.	32						
	31 std	circ.	6	0.682	12.0	17.6	46	49	59
	43 std	circ.	1						

std — Standard Twist Drill
*The primary aerations were determined by volumetric analysis (adsorption in pyrogallol) of oxygen content of throat gases. Within the table the relative values will be consistent although the absolute values may be subject to error inherent in this method of analysis.

Burners used in obtaining the data reported in this paper include:

a) Seven critical burners mounted in the open which have served as a reference test group for the other substitutability studies.[8, 9]

b) Selected contemporary range and hot water heater burners designed for operation on manufactured, mixed, and natural gases.

c) Thirteen selected critical and contemporary appliances also used in the oil gas substitutability program.[8, 9]

Test Gases

Substitutability tests were made with propane-carrier gas mixtures falling in the range from about 1000 Btu per std cu ft heating value to about 100 percent relative heat input. (Heat input factor, equal to heating value divided by square root of specific gravity, is the same for substitute and base gas.) The heating values corresponding to 100 percent relative heat input were about 1000 Btu per std cu ft for propane-hydrogen, 1200 Btu per std cu ft for propane-low gravity reformed gas, 1300 Btu per std cu ft for propane-high gravity reformed gas, and over 1500 Btu per std cu ft for propane-air.

Since the heating value and heat input of high-methane natural gas can only be duplicated with hydrocarbon-hydrogen mixtures,[9] it was necessary to compare the performance of the various propane-carrier gas mixtures containing CO, N_2, air of CO_2, both at constant heating value and various heat inputs, and at constant heat input and various heating values.

A number of gas mixtures simulating reformed gases were used because composition of catalytically reformed hydrocarbons varies considerably with feedstock, steam-hydrocarbon feed ratio, air-hydrocarbon feed ratio, process type (cyclic or continuous) and process conditions (catalyst activity, temperature, hydrocarbon feed rate per unit volume of catalyst).[5, 6]

In continuous reforming of natural gas with little excess steam and no air, the stoichiometric composition corresponding to the methane-reforming reaction

$$CH_4 + H_2O \rightarrow CO + 3H_2 \text{ (75\% } H_2\text{, 25\% CO)}$$

can be closely approached, although in presence of excess steam some CO_2 is always formed by the water-gas shift reaction

$$CO + H_2O \rightarrow CO_2 + H_2.$$

In continuous catalytic reforming, some air is normally used, particularly with a relatively high molecular weight feedstock such as propane or butane. This increases reforming capacity and reduces the tendency for the catalyst to lose activity due to carbon laydown or sulfur poisoning. In cyclic catalytic reforming, the most widely used carrier gas production process, feedstocks range from natural gas to kerosine.[5,11] Some blast gas dilution of the product gas and considerable gaseous hydrocarbon breakthrough normally occurs in this type of operation. Thus, in practice, reformed gases contain an average of only 50 percent hydrogen, and lesser amounts of carbon monoxide, carbon dioxide, methane, and nitrogen.

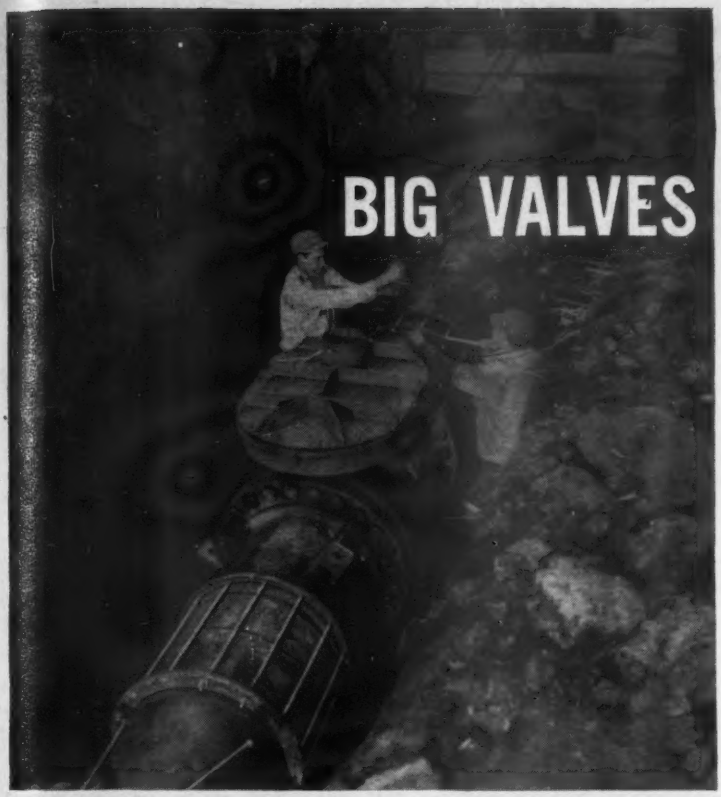
It is feasible to convert the CO content of the reformed product gas to CO and H_2 by catalytic water gas shift with steam at 650 to 900 F. This has no major effect on product gas heating value and specific gravity. Ideally, an 80 percent H_2, 20 percent CO_2 content gas could be produced from methane in this manner. The CO_2 can be removed by regenerative monoethanolamine or hot potassium carbonate scrubbing. At the low hydrogen purities adequate for utility gas production, additional costs of converting reformed gases to process hydrogen are relatively small.

Thus, at high levels of substitution, propane enrichment of process hydro-

TABLE 4. Characteristics of Contemporary Burners.

Natural Gas Design Group				Manufactured Gas Design Group				Universal Design Group			
Burner	No.	Port size std	Port loading Btu/hr-sq in.	Burner	No.	Port size std	Port loading Btu/hr-sq in.	Burner	No.	Port size std	Port loading Btu/hr-sq in.
Top	1	33	12,900	Top	2	49	42,800	Top	6Z	43*	20,600
Top	4	52*	17,500	Giant	3	49	40,300	Giant	7Z	43*	21,400
Giant	5	51*	19,000	Giant	11	37*	12,800	Hot water	12	53*	13,600
Top	6X	37/47	15,100	Hot water	14	44	38,400				
Giant	7X	33/47	15,800	Hot water	15	44	100,200				
Top	8X	29*	11,200								
Giant	9X	19*	10,900								
Top	10	33	16,300								
Hot water	13	33	22,100								
Hot water	16	33	58,200								
Oven	17	33	20,800								

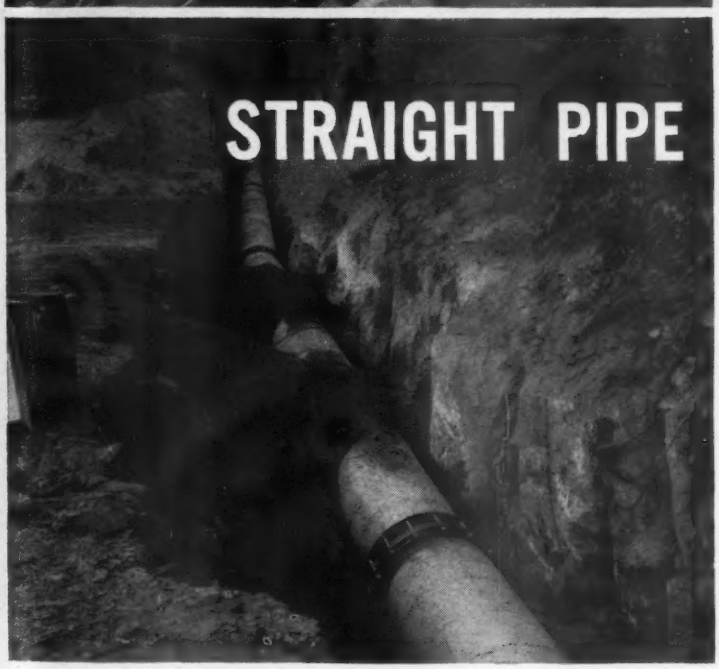
*Rectangular slot port — drill size denotes smallest dimension.



BIG VALVES GO IN FAST

... *the Dresser way*

These men are setting big valves and fittings the *easy* way ... the Dresser way. The assemblies were bolted and readied in the shop (or above the ditch), then connected up with gastight Dresser Couplings. No need for exact pipe fitting. No time-consuming back-breaking problems of misalignment. There's adequate "play" in the couplings to compensate for inexact pipe lengths and alignment.



STRAIGHT PIPE TAKES CURVES

... *the Dresser way*

Pipe goes in faster on the long stretches too, with time-proved Dresser Couplings. Slight changes of direction are accommodated in the couplings without costly bends and specials. With each of the Style 38 Dresser Couplings shown in this photo, you can take up to 6-degrees of deflection.

Test after test proves that Dresser Couplings are engineered to meet every requirement of the modern distribution system ... with unbeatable ease of installation, over-all economy and gastight safety at today's higher pressures.

Standardization on Dresser Couplings for all city distribution work is a step toward true economy. Why do it the hard way? ... when the Dresser way is easier and less expensive!

Bradford, Pennsylvania
Chicago
Houston
New York
Philadelphia
San Francisco
Toronto

DRESSER
MANUFACTURING DIVISION

ONE OF THE DRESSER INDUSTRIES

gen to a 1000 Btu per std cu ft, 0.6 specific gravity mixture of 100 percent relative heat input may be preferable to the production of higher heating value and specific gravity mixtures if it can be shown that propane-hydrogen has the required combustion characteristics.

Propane-enriched carrier gases studied in this investigation were mixed in a low-pressure gas holder from high-pressure cylinders of technical grade hydrogen, carbon monoxide, methane, carbon dioxide and nitrogen. Refinery-grade propane was used in the majority of mixtures (indicated by a propane-propylene ratio of about 10:1). The approximate compositions of the carrier gases simulating various catalytically reformed gases are shown in Table 1; the compositions of the test gases are shown in Table 2. Some of the minor test gas constituents may have been due to contamination with high-Btu oil gas used in a parallel study.

Burner Characteristics

In general, the seven critical burners (Table 3) had the same limiting characteristics on propane-enriched carrier gases as on oil gases; that is, flashback on turndown at moderately hard (+ 2) adjustments, and yellow-tipping at moderately soft (−2) adjustments. Burner B, however, did exhibit blow-off on the propane-air gases.

Characteristics of the selected contemporary burners used in supplementary tests are shown in Table 4 in groups corresponding to the manufacturer's specification of the type of gas for which the burner was designed (natural gas, manufactured gas, and universal).

Limiting characteristics for the natural gas group were the same as for the seven critical burners although this group generally was not as critical as the seven critical burners. One exception was burner No. 16, designed for hot water heaters and listed as being usable for natural gas, but with a port loading (5800 Btu per hr per sq in.) much higher than normal natural gas design specifications.

As a result, this burner operated on the natural gas adjustment with blow-off, the flame being stable at a point 1-in. from the ports. With propane-enriched carrier gases, the limiting characteristics on the hard flame adjustment tended to be blow-off instead of transient flashback, particularly on 1000 Btu per std cu ft propane-air gas.

Propane-enriched reformed gases, propane-air gases, and propane-hydrogen gases showed the same limiting characteristic of yellow-tipping at soft flame adjustments on all three groups of contemporary burners, as on the seven critical burners.

TABLE 5. Critical Burner Test Results for Various Propane-Carrier Gas Mixtures.

Test gas No.	Heating value, Btu/scf	Specific gravity (air = 1)	Relative heat input, %	Substitutability, percent* Flame adjustment −2	0	+2
			Propane-Reformed Gas (High Specific Gravity)			
11	960	0.762	83.7	100	62fb	62fb
10	968	0.789	82.8	100	75fb	60fb
12	1050	0.914	84.0	92yt	62fb	62fb
4	1132	0.942	86.6	78yt	92fb	78fb
14	1170	0.855	96.2	78yt	92fb	70fb
26	1290	0.921	102.2	66yt	81yt	70fb
			Propane-Reformed Gas (Low Specific Gravity)			
6	971	0.713	85.2	100	92fb	70fb
17	1018	0.701	92.3	78yt	78fb	—
5	1029	0.730	89.3	92yt	100	78fb
1	1133	0.778	95.4	—	78yt	78fb
25	1196	0.827	99.8	36yt	44yt	55fb
27	1258	0.856	103.3	20yt	32yt	55fb
			Propane-Air			
19	1008	1.180	70.4	92fb	48fb	48fb
20	1192	1.230	81.6	92yt	78fb	78fb
24	1413	1.293	94.5	55yt	78fb	78fb
2	1528	1.326	98.4	25yt	25yt	62yt
			Propane-Hydrogen			
29	997	0.591	98.5	70yt	92fb	62fb
28	1011	0.546	103.9	70yt	85fb	62fb
3	1027	0.595	98.8	55yt	63yt	62fb

*fb — limiting condition: flashback on turndown; yt — limiting condition: yellow-tipping.

For the manufactured gas group of burners, the limiting characteristics of propane-air gases were blow-off on the hard flame adjustments as well as yellow-tipping on soft flame adjustments. The severity of blow-off decreased as the heating value and relative heat input increased. Propane-hydrogen gases also showed a limiting characteristics of transient flashback on the hard flame adjustments.

At the initial adjustment of the manufactured gas burners on natural gas, three burners did not perform correctly. The two top range buurners (No. 2 and 3) changed from yellow-tipping to blow-off as the air shutter was opened, without a region of stable behavior. As shown in Table 4, these burners combine small port size (No. 49 std) with high port loadings (40,000 to 43,000 Btu per hr per sq in.), which favors blow-off of natural gas flames.

The third burner that did not show satisfactory performance was No. 15, the manufactured gas design of burner No. 16 discussed above. The two designs are identical in all respects except that the port side for the manufactured gas model is reduced from a No. 33 std to a No. 44 std, corresponding to an increase in loading to 100,000 Btu per hr per sq in. This high port loading further increased the tendency for blow-off.

The group of burners in the 13 contemporary and critical appliances showed the same limiting characteristics on propane-enriched gases as on oil gas. Ignition of range top burners, and carbon monoxide generation of appliance burners, did not appear to impose additional restrictions on substitutability. Specifications of the burners used in these appliance tests are given in detail in an earlier paper[8] and in an Institution of Gas Technology bulletin.[9]

Critical Burner Test Results

Substitutability data obtained with the five critical burners mounted in the open are presented in Table 5 and in Fig. 1 for each of the four types of carrier gas used: Low specific gravity (0.29 to 0.34) reformed, high specific gravity (0.39 to 0.55) reformed, air, and hydrogen. These data are arranged in order of increasing heating value in Table 5, and are plotted against the heat input relative to that of the base gas in Fig. 1.

Propane-Enriched Reformed Gases

For all reformed gas mixtures, substitutabilities at the soft (−2) adjustments decreased with increases in heating value and heat input, as would be anticipated when yellow-tipping is the limiting condition. This decrease was more severe for the low specific gravity reformed gas mixtures because of their higher heat input level in the 1100 to 1300 Btu per std cu ft range.

At normal (0) adjustments, substitutabilities increased with increases in heating value and heat input to a maximum level corresponding to a change in the limiting factor from transient flashback to yellow-tipping. The substitutability then decreased with further increases in heating value and heat input.

At hard (+2) adjustments, nearly constant substitutabilities (55 to 78 percent) were obtained with high and low specific gravity reformed gas mixtures over the whole range of heating values and heat inputs; transient flashback was always the limiting condition.

Propane-Air

Performance of propane-air mixtures was similar in some respects to that of propane-reformed gas mixtures. Yellow-tipping and transient flashback

The new Superior ALUMINUM CASE METERS

. . . the slow-motion meters you can rely on longer

This slow-motion, long-lived meter operates at only 7 revolutions per cubic foot to reduce wear and stay accurate longer. And its simple, horizontal seam construction gives fewer chances for leaks . . . makes maintenance quick and simple. Whether it's adjusting the tangent through the handy access in the top . . . removing the top to grind the valve seat . . . or lifting out the valve table with the entire inner movement to replace the diaphragm, simply loosening a few screws makes everything accessible.

Get full details. Send for bulletin 1150.

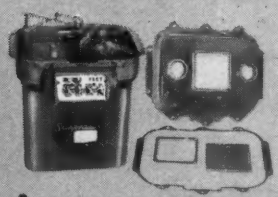
This modern meter exploits all the time-tested advances in meter technology *plus* the latest manufacturing techniques of Superior's new plant.

SUPERIOR METER COMPANY, INC.
19 West 50th Street, New York 20, N. Y.
A SUBSIDIARY OF NEPTUNE METER COMPANY

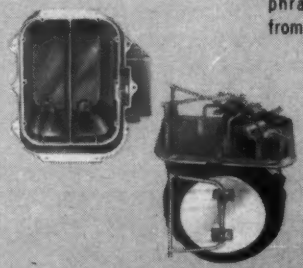
neptune

Look at these advanced design features:

1. Simple, horizontal seam . . . eliminates leakage . . . easier maintenance
2. Easily accessible table . . . just remove the screws holding top



3. Meter top removable without taking off index box
4. Valve seat readily accessible for grinding when top is removed
5. Slow movement; only 7 revolutions per cubic foot
6. Seam gasket stays resilient . . . cork and Buna-N composition
7. Valve table lifts out with entire mechanism



8. Heavy-duty, sintered bronze bearings oil-impregnated for life
9. Flag arrangement gives arm smoother operation and longer life
10. Accurately controlled diaphragm . . . no inaccuracies from deflection
11. Cupped handling lids permit easy and safe carrying
12. Handy access for tangent adjustment and calibration
13. Broad base for solid stacking . . . designed for conveyorized handling
14. Index removable without removing meter

In 250 cfh and 340 cfh sizes to meet most domestic requirements.

were again the limiting conditions, and at the normal (0) adjustments, an optimum substitutability level was attained with increases in heating value and heat input, accompanied by a shift from transient flashback to yellow-tipping as the limiting factor.

Due to the high specific gravity of the air carrier, the relative heat input at approximately 1000 Btu per std cu ft was only 70 percent, whereas the heating value required to approach 100 percent relative heat input was in excess of 1500 Btu per std cu ft. As a result, the limiting factor at the soft adjustments for the 1008 Btu per std cu ft propane-air mixture was transient flashback. This did not disturb the general trend of decreasing substitutabilities with increases in heating value and relative heat input, and the limiting factor at the hard adjustments for the 1528 Btu per std cu ft propane-air mixture was yellow-tipping.

For propane-air, the limiting factor at all three base gas adjustments was flashback at the 1000 Btu per std cu ft heating value level, and yellow-tipping at the 100 percent relative heat input level. It should be noted that with the 1008 Btu per std cu ft propane-air mixture, several contemporary burners in the natural gas group showed transient flashback and blow-off when the five critical burners indicated satisfactory flame appearance.

Propane-Enriched Hydrogen

Only a very narrow range of heating values (997 to 1027 Btu per std cu ft) at approximately constant heat input was explored. The performance of these mixtures were very similar to that of the propane-enriched high specific gravity reformed gases. Thus, the main advantage of reduction in the carbon oxides content of reformed carrier gases appears to be attainment of 100 percent relative heat input at the 1000 Btu per std cu ft level.

Appliance Test Results

Gases 1-6, Table 5, were tested on the group of 13 critical and contemporary appliances employed in the earlier oil gas study. This was done to establish the validity of substitutability values obtained from tests made on burners mounted in the open. Each gas was run at increasing dilution of base gas on the critical burner table until a given malperformance disappeared at −2, 0, or + 2 adjustments.

At this point, the appliances on the corresponding adjustment were tested for burner performance, carbon monoxide output, and ignition delay. This procedure was continued until all three adjustments had been tested. Satisfactory burner performance was found in all cases for these appliances, although slight lifting occurred with the 1528 Btu per std cu ft propane-air mixture (Gas 2).

Carbon monoxide content of the air-free flue gases from the appliances was, in general, about the same as those of the base gas. In 67 cases, values were less for the base gas. In 119 cases, values were less for the substitute gas.

Ignition delay periods for the substitute gases tended to be, on the average, slightly higher than for the base gas. They did not generally cause any difficulties in appliance operation.

Conclusions

Results of this study of substitutability of propane-enriched carrier gases for high-methane natural gas indicate that, over the normal range of moderately soft to moderately hard burner adjustments (−2 to + 2 AGA Code), yellow-tipping and transient flashback are the limiting conditions on contemporary and critical burners and appliances adjusted on the base gas. Lifting and blow-off were observed with propane-air gases in some instances.

High hydrogen content carrier gases, such as those produced by catalytic reforming of hydrocarbons and by further processing to remove carbon oxides, gave significantly better combustion performance than propane-air gases near 100 percent of relative heat input.

Over the range of adjustments on natural gas employed in this study, optimum overall substitutability of the propane-enriched reformed gases was about 80 percent at 90 percent relative heat input on a group of seven critical burners mounted in the open.

The gas mixtures that were substitutable on the critical burners also performed satisfactorily in respect to flame appearance, transient flashback, carbon monoxide generation, and ignition characteristics, at equivalent adjustments, on a group of 13 critical and contemporary appliances.

Propane-air also showed an optimum overall substitutability of 80 percent at the three natural gas flame adjustments, but at approximately 85 percent relative heat input. The optimum overall substitutability level of propane-air corresponded to a heating value of about 1200 Btu per std cu ft and a specific gravity of 1.2, compared to a range of 1000 to 1100 Btu per std cu ft and 0.7-0.9 specific gravity for the hydrogen-rich carrier gas mixtures.

As 100 percent relative heat input was approached, most of the propane-enriched reformed or process hydrogen carrier gases maintained a substitutability level above 60 percent, whereas the substitutability of propane-air gases dropped to 25 percent, due to the greater yellow-tipping tendency of propane-air in the 1500 Btu per std cu ft range. Overall substitutabilities of about 60 percent at 100 percent relative heat input were obtained with propane-hydrogen mixtures of only 1000 Btu per std cu ft and 0.6 specific gravity.

It appears that, in the substitution of propane-enriched carrier gases for high methane natural gas, better combustion performance at near rated heat inputs can be achieved at substantially lower heating value and specific gravity levels when high hydrogen content gases, such as catalytically reformed hydrocarbons or process hydrogen, are used instead of air.

Acknowledgments

Thanks are due to D. L. Nicol who conducted the earlier phases of this study. The authors also wish to acknowledge the assistance and guidance given by American Gas Association personnel at the New York headquarters, and the Cleveland laboratories, and by members of the Gas Production (now Gas Operations) Research Committee and its Supervising Committees concerned with the high Btu oil gas substitutability studies, in procuring the equipment and developing the test methods used in the work reported here.

This article was originally presented at the AGA Operating Section Conference, New York City, May 1958.

References

1. AGA Testing Laboratories, "Interchangeability of Other Fuel Gases with Natural Gases," *Research Bull.* 36 February 1946.
2. Boyer, E. G. chairman, "Interchangeability of Various Fuel Gases with Manufactured Gases," p. 45, Summary Bull., Gas Production Research Committee Project TL-1, AGA Laboratories, Cleveland, 1950.
3. Carroll, J. W., "Investment and Operating Costs for Producing High-Btu Oil Gas," *Paper CEP-57-4*, Operating Section, AGA, 1957.
4. Fleming, G. L., "Hydrocarbon Reforming by a New Pyrolytic Process," *Chem. Eng. Progress* 52, 249-54 (1956).
5. Morgan, J. J., "Catalytic Cracking Processes," Part 1, *Gas Age*, 110, 59-65 (November 20, 1952); Part 2, *ibid.*, 110, 41-45 (December 4, 1952); Part 3, *ibid.*, 110, 38-45 (December 18, 1952).
6. Riesz, C. H., Lurie, P. C., Tsaros, C. L. and Pettyjohn, E. S., "Pilot Plant Catalytic Gasification of Hydrocarbons," *Institute of Gas Technology Research Bull.* 6, July, 1953.
7. Rogers, O. F., North Shore Gas Company, Waukegan, Illinois, private communication, 1957.
8. Searight, E. F., Boyd, J. R., Parker, R. and Linden, H. R., "Appliance Tests on the Substitutability of High-Btu Oil Gas for Natural Gas," *AGA Proc.* 1954, 675-97.
9. Searight, E. F., Lindon, H. R., Nicol, D. L. and Pettyjohn, E. S., "Interchangeability of High-Btu Oil Gases and Natural Gases," *Institute of Gas Technology Research Bull.* 24, January 1956.
10. Shnidman, L., "Gaseous Fuels," 2nd ed., pp. 179-202, 389-410, AGA, New York, 1954.
11. Smoker, E. H., "Experiences in the Production of High-Btu Gas from Naphtha and Kerosene Using the UGI Cyclic Catalytic Reforming Process," *AGA Proc.* 1953, 852-53.
12. Stone and Webster Engineering Corporation, "Gas Storage at the Point of Use," Gas Operations Research Committee Project PT-24, AGA, New York, October 1957. ★ ★

Toward Better Management

One of a Series

How to Compliment Your Employees

H. E. Carroll

COMPLIMENTS have been described as verbal vitamins to give employees an added lift. As you use compliments in dealing with people under your supervision in your gas company, you will find that they are powerful stimulants to get better cooperation.

There are three types of compliments you can use in dealing with your employees:

1. First person,
2. Second person,
3. Third person.

First person compliments are those given directly to employees. You come right out and make a sincere compliment to the employee. Here are a few examples of first person compliments:

"You have the highest record in the department."

"I am mighty proud of your safety record."

"I wish everyone had as many good ideas as you do."

Second person compliments at times are more effective than the direct type. In this type of compliment, you "pass along" words of praise. It is often more believable and shies completely away from flattery.

Here are a couple of illustrations of this type of compliment:

"The front office was bragging to me about your safety record."

"Jim was telling me how you . . ."

To use second person compliments successfully, you need to be attentive to all compliments others give those under your supervision. Then, you casually "pass along" the verbal vitamins to the employee for an effective compliment.

Third person compliments can be most effective in dealing with employees under your supervision. You have an opportunity to "bank" your compliment and get more cooperation from two people instead of one as with most compliments.

For instance, you might say to Bill: "Jim sure turned in a swell suggestion the other day." Bill in turn passes the compliment along to Jim. They both feel good — Bill because he has a compliment he can pass along, and Jim because he receives a compliment.

When you use the third person compliment, be sure you are not knocking the person you want to pass the compliment along. For instance, if you had said to Bill: "Jim is the best man in the department," it might boomerang. Bill might think you are telling him he is no good.

Here are some rules successful supervisors follow in passing out verbal vitamins:

RULE No. 1: **Don't flatter — compliment.**

Flattery is insincere. To make your compliments effective, you need to believe what you say. Be sincere. Base your compliments on facts, and you will have an honest, sincere compliment.

RULE No. 2: **Turn doubts into compliments.**

Complimenting Miss America on her beauty would not be a strong compliment. Or, complimenting anyone on anything of which they are sure is not good strategy. But, you can pack power when you compliment a person on something he doubts.

For instance, one of the men in your department comes to you about an idea for a change. You can tell whether or not he has any doubts by the way he presents his suggestion. If there is any doubt in his mind, you have a wonderful opportunity to compliment him on his well-thought-out suggestion, his loyalty to the company, or on his creative powers.

RULE No. 3: **Be specific in your compliments.**

Single word compliments are weak. Words like "swell," "fine," "wonderful," and "good" are not the most effective compliments. They are not specific, and lack the power of a good verbal vitamin.

Give your verbal vitamins more power by being specific. Instead of saying, "You have a fine safety record," say "Six years without an accident is a safety record to be proud of."

When you compliment an employee on his production record — repeat the figures of the record. When you compliment a man on a suggestion — repeat the suggestion as specifically as possible. Thus, you will make your compliment more believable and take it out of the "flattery" classification.

RULE No. 4: **Use comparative compliments.**

Superlative words like "most" or "best" are apt to be taken as flattery. You will find, too, that when you use the comparative form (more or better), you can do it again and again. Something that is the "best" or the "most" is just that — no chance for improvement.

There are other ways you can use the comparative form in your compliments. You might say:

"This is the best I have seen . . ."

"That looks like one of the most effective suggestions that has been submitted."

You can use the superlative form if you compare it with something. For instance, the first example cited compares the "best" with the supervisor's experience. The second example compares it through the use of "one of the most" to qualify the superlative statement.

RULE No. 5: **Have plenty of variety.**

Verbal vitamins need to have variety. Repeating the same compliment day-after-day to the same employee will be a boomerang. Add variety to your compliments to keep them on the believable level. And, as you know, it is mighty hard to be sincere about the same thing time-after-time.

You can compliment employees on their attendance, performance (broken down into specific tasks), safety, ideas, outside achievements (sports, election to office, etc.), and on their family. A little searching will reveal plenty of things your employees do that can be complimented sincerely.

Another way to add variety to your verbal vitamins is to vary the method used. Today give a first person compliment, tomorrow make it second person, and the next day try a third person compliment.

Successful supervisors give plenty of compliments to their employees. They know these non-financial verbal vitamins improve morale, increase cooperation, and get more accomplished in your gas company. * * *

Pioneer "Master Meter" Installation. American 500-B Ironcase Meters, one with Volume and Pressure Gage, record volume and pressure of gas delivered to a group of wells on Pioneer's line.

where the crops grow greener...

THANKS TO NATURAL GAS

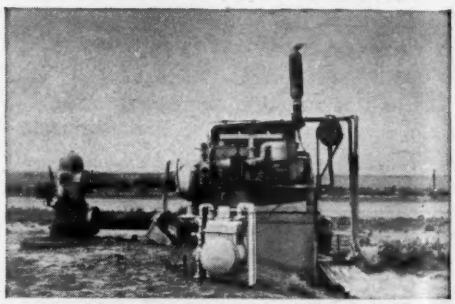
From 18,000 irrigation wells over 10,000 miles of pipe carry water to irrigate nearly 3 million acres of Texas farm land in 23 counties in the Lubbock, Hereford and Amarillo areas served by Pioneer Natural Gas Company. Natural gas powers the well pump engines for less than half the cost of other fuels.

Irrigation has become a dominant factor in the agricultural economy of the area served, resulting in greater crop yields and profits. And, Pioneer's peak load is no longer in winter, but in summer.

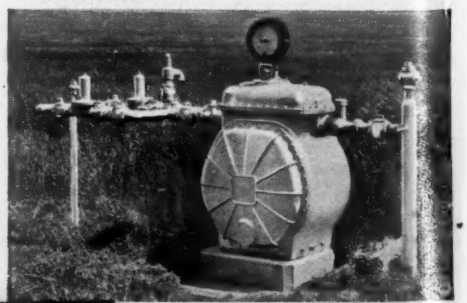
Pioneer delivers gas from its irrigation feeder lines to groups of ten to twelve wells through a "Master Meter" installation. Lines from the "Master Meter" to the wells are owned by the farmers but delivery to each well is measured at the internal combustion engine.

American Ironcase Meters are used at "Master" and wellhead measuring points.

Wherever ability to withstand the elements and to produce sustained accuracy at low maintenance cost is required, you, too, can benefit from American engineering and American equipment for measurement and control.



Well Set Readings at each pumping operation are made by American 35B Ironcase Meters. Occasional differences between "Master" meter and "well set," readings represent line losses which are pro-rated among farm customers by Pioneer Natural.



Volume and Pressure Gage (0 to 100 lb.) on 500-B Ironcase Meter and two Reliance Type HPR-10 Regulators at each Pioneer "Master Meter" installation, operate at 40 to 50 pounds pressure.

AMERICAN METER COMPANY

GENERAL SALES OFFICE: Philadelphia 16, Pennsylvania
Albany • Alhambra • Atlanta • Baltimore • Birmingham
Boston • Chicago • Dallas • Denver • Erie • Houston
Kansas City • Los Angeles • Minneapolis • New York
Omaha • Pittsburgh • San Francisco • Seattle • Tulsa
Wynnewood, IN CANADA: Canadian Meter Company, Ltd.,
Milton, Ontario • Calgary • Edmonton • Montreal • Regina

SUPPLIERS TO THE GAS INDUSTRY for Ironcase, Tinned Steelcase, Aluminumcase and Welded Steelcase Meters

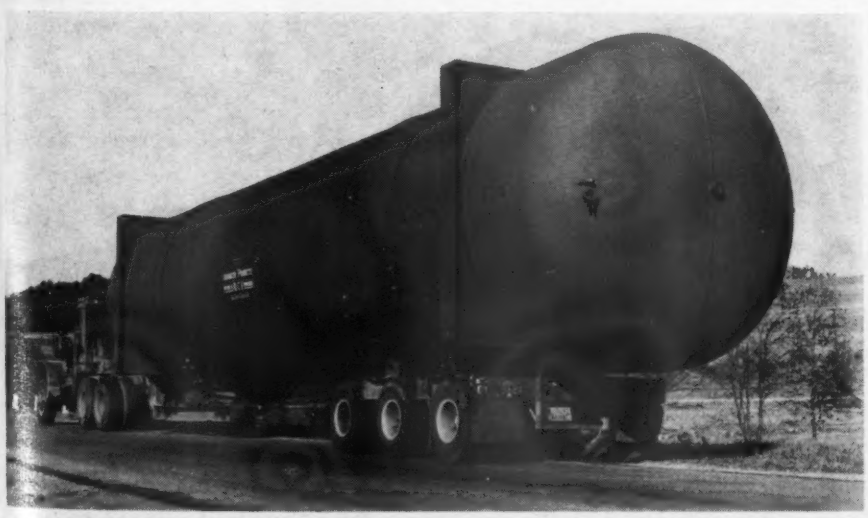
American-Westcott Orifice Meters • Instruments • Reliance Regulators • Apparatus • Valves

Swinging boom lets 'er down easy as construction crew makes pipe lineup in Weedsport, New York, preparatory to welding the joint. New gas distribution system was installed by New York State Electric and Gas Corporation.

"WHERE GAS IS GROWING"...

Distribution Developments

... news about current and planned construction



Tank or truck? Both. This big, fat looking tank is actually 16 percent lighter in weight than conventional tanks and 30 percent shorter. Designed for high pressure LPG storage, the 30,000-gal unit can be moved on a special rig whereby the tank acts as its own bed. Unit moves only in daylight hours, in good weather, on prescribed routes and requires special state permits. Many such tanks may soon be seen moving on U. S. highways as use of LPG for peak shaving grows in nation's gas distribution industry.

Missouri Public Service Company, Kansas City, Missouri, has underway a number of construction projects in the communities it serves in Missouri. These include, at Nevada, 10,760 ft of 2-in., 17,025 of 4-in., and 2400 ft of 6-in. intermediate pressure main extensions, costing approximately $119,747, with work to be done by company crews. At Chillicothe, the company is installing 6600 ft of 2-in. and 13,344 ft of 4-in. low pressure main extensions, to cost approximately $66,500. At Trenton, work is underway on 4480 ft of 2-in. and 6770 ft of 4-in., both low and intermediate pressure main extensions, at a cost of approximately $32,304. A total of 15,050 ft of 4-in. low and intermediate pressure main extensions will be installed in Sedalia, at an estimated cost of $56,978. At Lexington, company crews are installing 10,700 ft of 2-in. low and intermediate pressure main extensions at a cost of $18,500. In Richmond, 1000 ft of 2-in. intermediate pressure main extensions are being installed at a cost of approximately $15,000. Low and intermediate pressure main extensions in Marshall will total 5000 ft of 4-in., at a cost of approximately $13,100. In Platte City, installation is underway on 5050 ft of 6-in. intermediate pressure main extensions, costing approximately $13,000. In Brookfield, 5200 ft of 2-in. and 5000 ft of 4-in. are being installed at an approximate cost of $24,400.

PIPE REPAIR PERMANENCE

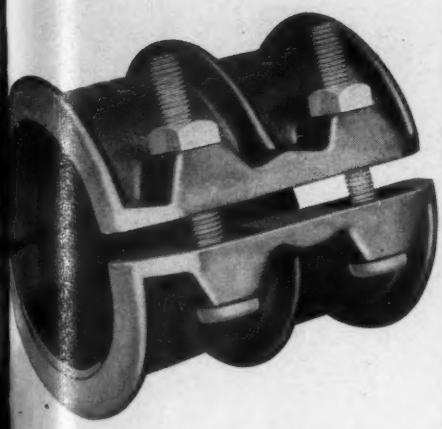
Made of malleable iron

Designed for rugged use, the Emergency Pipe Clamp is a clamp of almost unlimited strength. Fifty years of experience have gone into its design . . . the heavy ribbing to "take" the bolt-pull, the skillful shaping of the bolt lugs for terrific strength and a free wrench swing. Full length, massive hinge which no strain can loosen! Ample thickness of metal throughout to withstand any pressure!

When you put on the Emergency Pipe Clamp, it is there to stay. Tens of thousands of them are still in place after 20, 30, 40 years' service. Made in C. I. and steel pipe sizes—½″ to 12″ inclusive.

Write for Catalog GW
M.B. SKINNER CO., South Bend 21, Ind.

SKINNER-SEAL EMERGENCY PIPE CLAMP



In 1904 the SKINNER-SEAL Emergency Pipe Clamp was introduced to the gas industry.

Quite a record—54 years! Progressively redesigned and improved over the years to meet rising pressures, this clamp is unique. Look at the massive malleable iron construction—the full-length hinge—the extra-oversized plated bolt. This clamp is made to last—to resist erosion and corrosion for decades.

This clamp is made to fit. Every single Emergency Pipe Clamp that we ship is first assembled over a mandrel in a tremendously powerful air vise, which by sheer brute force fits the clamp to the exact contour of the pipe. During the operation, our workman sledges the clamp from every conceivable angle to make sure the fit is perfect, the "seating" of the full length hinge is "set".

Should a casting have a flaw, the clamp, of course, breaks under the six-ton pressure of the air vise. Having survived the pressure of this great vise, you can be sure of one thing—no *SKinner-SEAL* clamp will ever break in service.

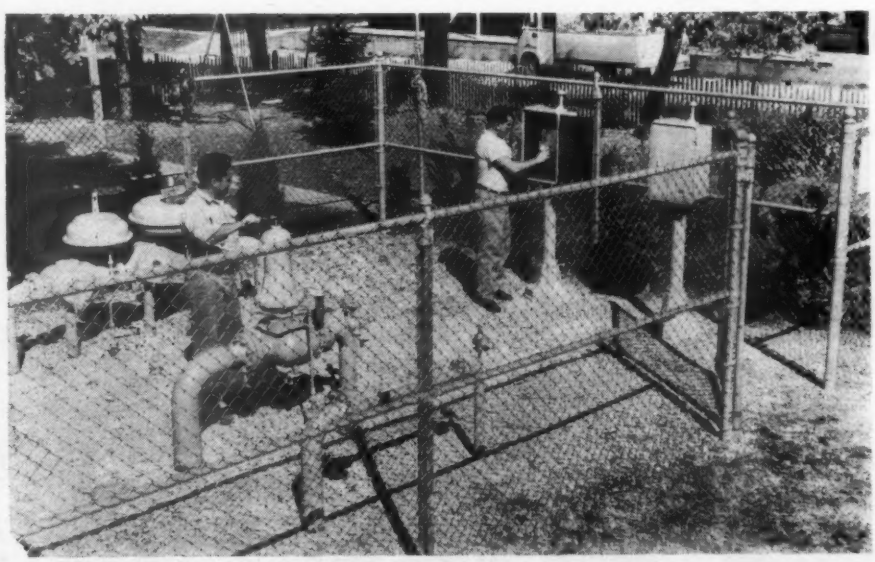
Our ideal is PERMANENCE. Old customers who have been buying this clamp for half a century, know how well it has fulfilled that ideal.

M. B. SKINNER CO.
SOUTH BEND 21, INDIANA

System gas maintenance crews at Arizona Public Service are now using this new welding rig assembled at the company's Grant Street yard. Designed and built almost entirely by welder Art Dennis, left, the rig is equipped with a 200-amp unit and features many improvements over facilities previously available to crews. Other features of the new rig include:

1. Work area in rear of truck is ½-in. steel plate, 29-in. above the ground. Area is 14-in. deep and 83-in. wide. The 6-in. detachable rails may be easily removed to expand working area to 36-in. deep.
2. Detachable pipe rack on left side of truck (not shown in photo) holds eight 2-in. pipes, 21 ft in length.
3. Lead reel on right side of truck holds 300 ft of cable. Reel on left side of truck is ground cable.
4. Vise on right side is a combination machinist-pipe vise.
5. Detachable pipe rollers hold pipe in position, as demonstrated in photo by welder Harry Kleindorfer with some 4-in. pipe.
6. Truck has five tool drawers, two on each side, and one in rear.

Wisconsin Public Service Corporation, Milwaukee, Wisconsin, in the 12 month period ahead, plans expenditures of $1,825,000 for additions and improvements to its gas distribution system, comprised mainly of gas main extensions in newly-developed business and residential areas and for strengthening of its existing gas system. Company also plans to spent $160,000 for modernization of its sales, service, and office buildings. Vehicle and equipment replacement is expected to cost approximately $280,000.



Periodic maintenance is a must for continuous operations. Shown here are two Northern Illinois Gas Company personnel at Joliet, Illinois, conducting part of regulator station overhaul procedure. Ray Mores, left, adjusts regulator while Bob Smith, right, checks regulator chart.

Portland Gas & Coke Company has laid a new 12-in. pipeline across the Willamette River a short way upstream from the downtown business district. Immediate purpose is to supply natural gas from east-side source to the west bank steam-electric generating station of Pacific Power & Light Company. Hood Northwest Pipeline Company, Boise, Idaho, laid the line, which included 1700 ft actually underwater. Because of shipping, line was placed in ditch at minimum low-water depth of 35 ft. Willamette Tug & Barge Company subcontracted the dredging and backfilling.

Welder connects first 1000-ft section, which already has been pulled into river by a stationary winch, onto second 850-ft section for rest of pull. Concrete jacket will hold pipe at bottom of ditch. In background looms PP&L's Lincoln street station, which will start using natural gas on seasonal basis in July. Gas will be used in dual gas-oil burner in largest of its nine steam boilers. The 4000-ft project extends from line already serving east-side standby steam plant of Portland General Electric Company.

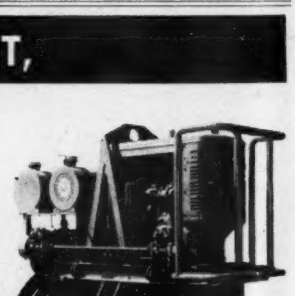
A FAVORITE EVERYWHERE . . . CROSE EQUIPMENT,

MATERIALS & SUPPLIES

FOR GAS DISTRIBUTION . . .
Construction and Maintenance Work

- **CROSE CLEANING AND PRIMING MACHINES. In both line-traveling and stationary models . . . for faster, trouble-free service.**
- **CROSE COATING AND WRAPPING MACHINES. For uniform coating and precision wrapping . . . they coat Bends or "Egged" pipe. Models built for line-traveling or stationary use.**
- **BLUE FLAG L-O-F GLASS FIBER PIPE WRAP, JOHNS-MANVILLE FELT, SEALTIGHT PIPE SHIELDS.**

Crose offers a most complete line of equipment for the gas distribution industry. Crose equipment, materials and supplies are always available to you on shortest notice—we have many strategic supply points and use fastest transportation methods. Always check first with Crose on any pipeline construction and maintenance needs.



M. J. Crose MANUFACTURING COMPANY, INC.

2715 DAWSON ROAD • TULSA, OKLAHOMA • PHONE MAdison 6-2171 • New York, N.Y. Ph. BRyant 9-2236 • *Denver, Colorado Ph. EMpire 6-0332 • *Houston, Texas Ph. MIssion 5-2484 • *Elizabeth, N. J. Ph. ELizabeth 4-4244
DISTRIBUTOR: CROSE-CURRAN LTD.—*Edmonton, Alberta Ph. 3-5135 *Winnipeg, Manitoba Ph. SPruce 4-1851
*Warehouses in 5 locations

By Popular Request–

Sherman re-introduces its low cost "C" digger

1500 psi operating pressure
Control valves permit multiple cylinder operation simultaneously
Reach below grade 10', behind rear axle 14' 4", loading height 7' 2"
140° arc of swing
Self equalizing, independently operated stabilizers

in an improved model— the BOBCAT

There are many reasons why the "good old," dependable Sherman "C" was so well liked by excavators and why the new Bobcat will be even more popular—

- The Bobcat has a fast operating cycle, moves earth quickly and economically.
- The Bobcat is extremely stable particularly when working directly behind the tractor where 90% of all digging is done.
- The Bobcat digs close to the tractor, permitting easy maneuverability in tight places.
- The Bobcat is mounted close to the tractor controls, making it easy for the operator to change tractor positions and adjust throttle settings.
- The Bobcat will have a high trade-in value because used Shermans are in big demand.
- The Bobcat is sold and serviced by Ford Tractor Dealers so parts and service facilities are always close at hand.

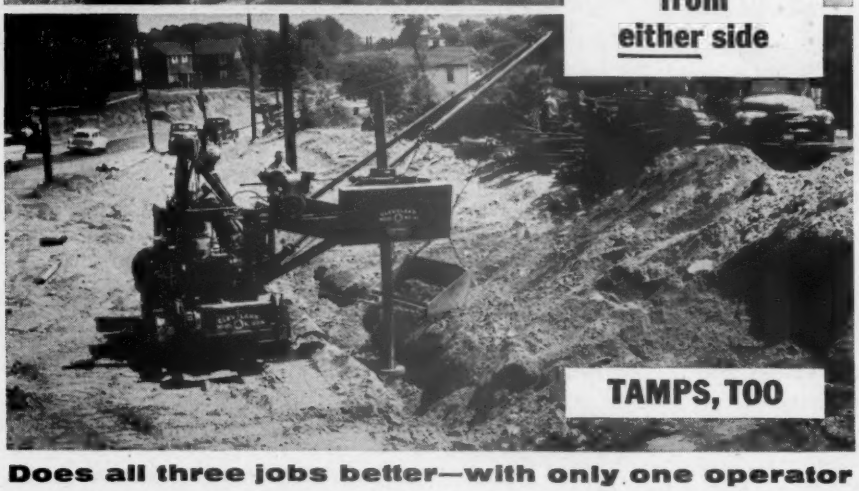
Ask your Ford Tractor Dealer for a demonstration of the low cost Bobcat on *your* job.

Write today for Bulletin No. 3181

Sherman Products

SHERMAN PRODUCTS, INC.
Royal Oak, Michigan
POWER DIGGERS • LOADERS • FORK LIFTS
SOIL WORKING TOOLS • CRANES AND EXCAVATORS

CLEVELAND 80W



Does all three jobs better—with only one operator

Lays pipe • 30,000 foot-pound capacity—power boom, up and down • 4 line speeds • long reach, 21 feet • sets hydrants, valves • unloads, strings • pulls street crossings • handles headache ball.

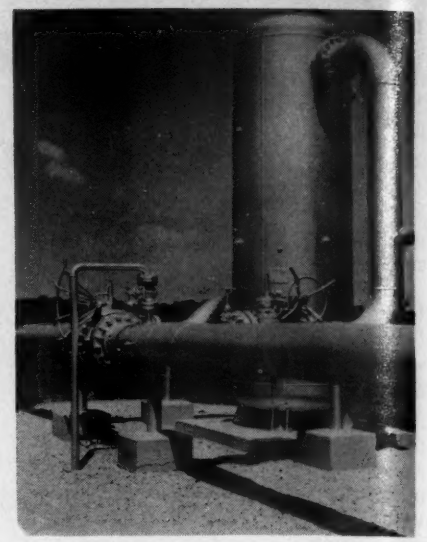
Backfills fast—from either side of trench • 20 passes per minute • 4½ foot scraper board • backfills clean • stays off completed work • works safer, parallels work • fits all job conditions.

Tamps as it fills • meets rigid density specifications • tamps from the bottom up • parallels work, no straddling • tamps wider, tamps safer • breaks concrete • reduces haul-out • saves clean-up.

The CLEVELAND TRENCHER Co.

20100 ST. CLAIR AVE. • CLEVELAND 17, OHIO

Good Everywhere



Sand, pipe scale, and other foreign matter in the gas stream from Laclede Gas Company's underground storage area at Florissant, near St. Louis, never reach the compressor engines that pump the gas back to the city mains, thanks to this "liquid washing" gas scrubber. The entrained foreign matter, which would quickly ruin the compressor cylinder walls and pistons, is completely removed by the scrubber. The scrubber consists essentially of a vertical tank containing an oil reservoir, scrubbing section, primary oil separator, and a final mist extractor. Incoming gas enters at the bottom and then flows upward through contactor tubes where it is intimately mixed with the oil, then goes through separators to the outlet, removing all damaging dust and foreign material. Unique feature of Laclede's underground storage is that—unlike many—it never held gas before. Storage gas is forced down into a porous sandstone stratum enclosed by impervious rock and salt water. Most fields used for underground storage are depleted gas fields.

Portsmouth Gas Company, Portsmouth, Virginia, is nearing completion on the construction of 4440 ft of 2-in. city main, including installation of services, meters, and regulators. Company crews are performing the work. During the previous year, company installed 1250 ft of 3-in. main and 33,840 ft of 2-in. main, along with services, meters, and regulators.

Brockton Taunton Gas Company, Brockton, Massachusetts, plans construction of 38,400 ft of 8-in. intermediate pressure line at Norwell, with work to begin in July, job to be contracted. Other new main installations planned or underway include 5000 ft of 6 in. intermediate pressure line at Stoughton and Canton, 3400 ft of 3-in. intermediate pressure line at Marshfield and Norwell, 17,000 ft of 2-in. intermediate pressure line at Marshfield and Brockton, and 15,000 ft of 1½ in. intermediate pressure line at Marshfield. The new construction involves mains to serve new housing developments. All work is contracted to Allan R. Wheeler Company.

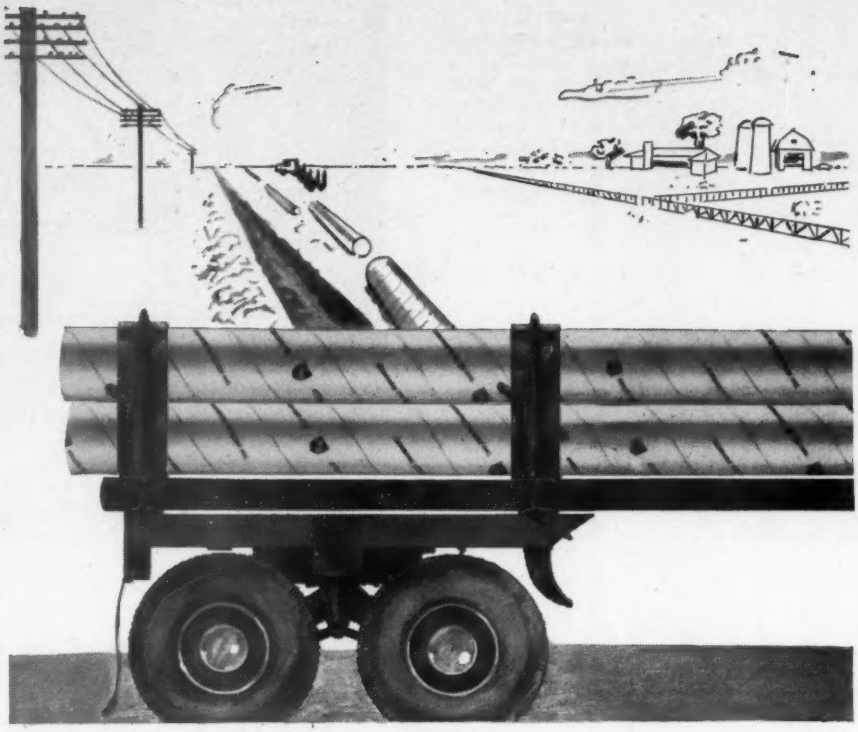
Distribution Developments

The East Ohio Gas Company, Cleveland, Ohio, during 1958 plans installation of approximately 3,696,000 ft of 2 to 20-in. mains, services, and other lines, scheduled for installation in most of the 150 communities in its service area. Most of the work will be performed by contractors. Scheduling of projects is dependent upon weather conditions.

Florida Public Utilities Company, West Palm Beach, Florida, has underway or scheduled for early summer construction projects throughout its area. Included are 6000 ft of 6-in. intermediate pressure system, in Lake Worth, to cost an estimated $50,000; 3000 ft of 4-in. intermediate pressure main in the West Ward of West Palm Beach, at an estimated cost of $7000; installation of 15,000 ft of 2-in. main extensions of various lengths in West Palm Beach, to cost approximately $13,000; and installation of a 300-ft, 6-in. water crossing at West Palm Beach, to cost approximately $11,000.

Northern States Power Company, Minneapolis, Minnesota, and its subsidiaries plan to install in 1958 some 356,400 ft of 2 through 16-in. coated steel main at a cost of approximately $1,800,000. For rehabilitation of existing facilities, the company will spend approximately $210,000, and additions of its propane-air plant facilities will total about $590,000. Major part of this work will be done in the St. Paul, Minnesota, division of the company. Several NSP communities are included in applications for service in FPC Docket G-2306 et al, and if one or more of the pipeline suppliers is certified, NSP plans installation (in addition to above) of 1,140,000 ft of coated steel main, 2 through 16-in., at a cost of $6,160,000. Approximately 40 percent of this will be in Minnesota and 60 percent in Wisconsin.

Northwestern Utilities, Ltd., Edmonton, Alberta, Canada, has underway a record expansion program costing an estimated $6,500,000, designed to bring natural gas service to numerous new areas in its service territory. Natural gas service is planned for the cities of Provost and Cadogan, southeast of Edmonton, to be built at a cost of $310,000. Facilities will also be built in the communities of Oyen, Consort, and Monitor, at an estimated cost of $210,000. Extensions of the company's present distribution systems will be made at a cost of $400,000, while installations for new customers, and for measurement and pressure control equipment will cost an additional $700,000. Further improvements of the company's system will cost another $320,000.

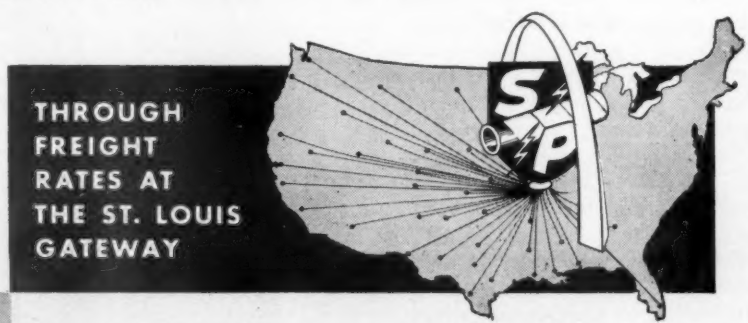


To the Ditch in Time!

One of the most important factors in a successful pipe line job is the timing. If your pipe does not arrive at the ditch on schedule, the entire job is delayed and costs mount.

At SPI, everyone in the organization is trained to complete your coating and wrapping in accordance with your specifications, in time for all shipments to be made as requested by you.

Count on SPI to ship your pipe where you want it, when you want it. "To the ditch in time" is more important than a stitch in time.



SPI®
standard pipeprotection inc.
3000 SOUTH BRENTWOOD BLVD. • ST. LOUIS 17, MISSOURI

Newest concept of modern homemaking is embodied in this dramatic Multimatic Wall. Colorful, compact installation includes foldaway cooking burners, wall oven-broilers, refrigerator, water heater, washer-dryer and warm air furnace.

It's New!
It's Sensational!
It's the . . .

All-Gas Multimatic Wall

from AGA research comes an amazing appliance center to build a house around . . .

HOME APPLIANCE DESIGN has taken a giant step forward with the introduction of an exciting new *Multimatic Wall* developed by the American Gas Association.

Handsomely styled, the *Multimatic Wall* combines cooking, laundering, refrigeration, house heating, and water heating in one compact unit.

The result of two years of intensive research and development by the gas industry through the Association's PAR Research Program, the space-saving unit offers maximum efficiency and convenience within a limited area.

The project had its inception in 1955. After broad design objectives had been established by a special research committee, AGA retained Walter Dorwin Teague, leading design and engineering development firm, to design and build the prototype model.

Made entirely of steel in color-coordinated baked enamel finish, the *Multimatic Wall* is 10 feet wide, 7 feet 11 inches high and 33 inches deep. On the left is a built-in waist high oven, beneath which is a counter top broiler and three storage drawers. On the extreme right is a large refrigerator with a deep freeze compartment. Between the oven and refrigerator is a 5-foot stainless steel counter which has a washer-dryer and water heater below. Along the top of the counter are five fold-away surface burners which pivot down for cooking. Running across the entire top of the unit, behind a series of storage cabinets, is a horizontal heating system. The furnace is readily adaptable to gas air conditioning.

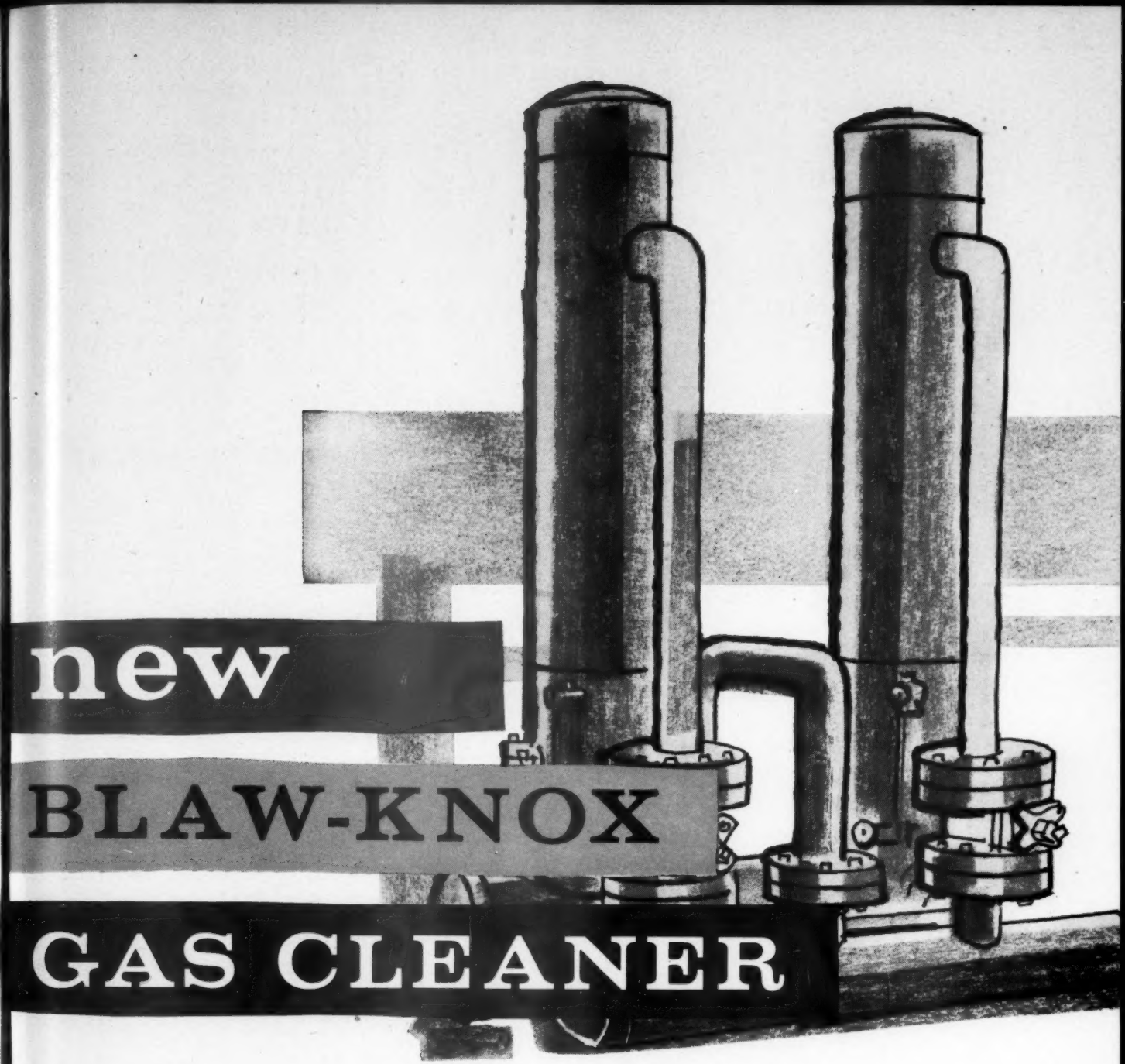
While the all-gas appliance center is designed for installation in the kitchen, it is not offered as a complete kitchen. To permit architects and builders greater flexibility in the placement of dining and clean-up areas, a sink and dishwasher are not included.

Savings in building costs are realized because the *Multimatic Wall* integrates all of the major home appliances in one compact, space-saving unit. This eliminates the need for a basement, utility room, and separate laundry area, making it particularly attractive to builders of large-scale developments, as well as owners of apartments, summer homes, and multiple-family dwellings.

Inexpensive installation is made possible by the incorporation in the unit of most of the plumbing and all of the flue requirements. An outside terminal, which can be located on the rear or at either end of the *Multimatic Wall*, exhausts all products of combustion to the outside and makes construction of a chimney and one interior wall unnecessary.

The *Multimatic Wall* has been thoroughly tested for safety, durability, and performance. It is expected that the all-gas appliance center will be marketed at a price lower than the total cost of individual components. It can be shipped completely assembled and requires only a simple, inexpensive installation.

More than 18 cu ft of storage cabinets is included in new Multimatic Wall. Compact unit is 8 ft high and 10 ft wide.



new BLAW-KNOX GAS CLEANER

provides cleaner, drier gas ... increased capacity

From Blaw-Knox comes a new pace setting gas cleaner. Using all the proven advantages of oil scrubbing, the new cleaner incorporates unique design features developed out of 28 years of field experience. The same neat exterior has been retained to match existing facilities.

You can expect:

More efficient dust removal—eliminating all pipeline dust throughout the entire operating range regardless of particle size.

Reduced liquid loss—operating with extremely low loss of scrubbing liquid.

Minimum maintenance—no moving parts, no filtering or screening section, no high pressure stuffing boxes, no cyclones.

You can cash in:

. . . by using this new cost cutting cleaner at your compressor stations, district regulators, town border stations or wherever highest efficiency is needed.

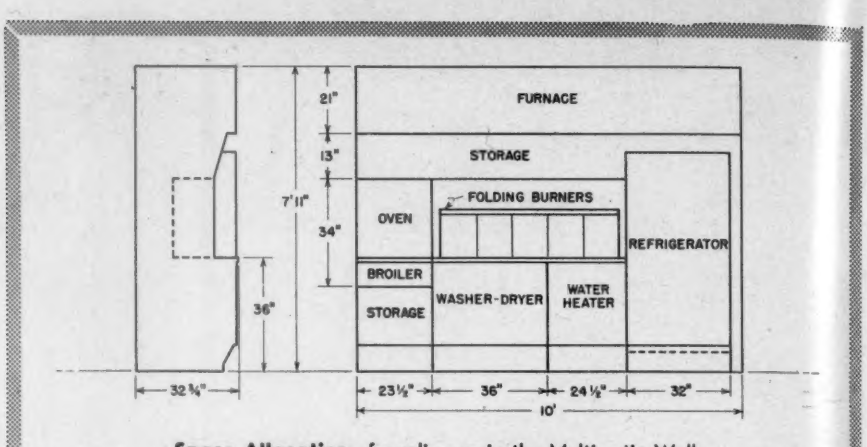
Contact Blaw-Knox today for the industry's most modern gas cleaner. Note your maximum hourly load, minimum pressure at peak, and maximum pressure for which your all-new cleaner should be designed.

BLAW-KNOX

BLAW-KNOX COMPANY

Buflovak Equipment Division
1646 Fillmore Avenue, Buffalo 11, N. Y.

FACTS ABOUT THE ALL-GAS "MULTIMATIC WALL"



Space Allocation of appliances in the Multimatic Wall.

The all-gas *Multimatic Wall* is a new appliance concept, which combines five major household uses of gas in one compact unit. Designed for installation as a kitchen wall, it performs the following appliance functions:

Gas cooking
Gas refrigeration
Gas hot water heating
Gas laundering (washer-dryer combination)
Gas house heating
(Gas air conditioning can be added)

Dimensions are: length, 10 feet; height, 7 feet 11 inches; depth, 33 inches. Measurements include approximately 18 cu ft of storage space. Appliance components are of standard size.

Major Advantages

1. **Space saving.** Consolidation of appliances results in most efficient use of space. Construction as a wall enables use as one interior partition, and saves space normally occupied by free-standing appliances. Inclusion of laundering and house heating eliminates the need for a basement or utility room.

2. **Convenience.** Compactness allows most household tasks to be performed within an area of a few feet. Food storage and cooking are provided for in the same unit. Range-top burners fold into the wall to provide extra counter space. Necessary plumbing and wiring are contained in the unit, so that only one installation is needed to connect entire wall. For builders, it simplifies purchasing and handling, since the unit can be bought completely assembled and shipped ready for installation.

3. **Economy.** Purchase price for the complete unit will be less than for the appliances bought separately. Extra installation costs for separate appliances are eliminated. Since the self-contained venting system makes a chimney unnecessary, cost of chimney construction can be eliminated. By use of the unit as an interior wall, cost of constructing one partition may be saved. Use of gas in five ways enables owners to take full advantage of lower cost for gas compared to competitive fuels, resulting in lower utility bills.

4. **Performance.** The *Multimatic Wall* prototype is a laboratory model which has undergone exhaustive tests for safety, durability and performance.

Components

Oven-broiler (21,000 Btu input). Waist-high oven, automatic timing and ignition. Broiler door is incorporated into a folding section of the counter to provide ease of transfer from broiler to counter and to create a longer counter design. Door automatically folds down into a stainless shelf as it opens. Air for combustion is drawn from the house exterior through the internal ventilating system, which also exhausts all cooking odors and combustion products to the outdoors.

Washer-dryer (19,000 Btu input). Direct air intake and exhaust system divorces the drying system from the house interior for fast, efficient drying. Controls are conveniently located below the upper cabinets and away from the reach of small children. Soap and dryer filter access is through the counter.

Water heater (25,000 Btu input). Water heater is installed under the counter between the washer-dryer and the refrigerator. All usable space in front of the heater is utilized for storage. Water heater control provides 100 percent shut-off protection.

Refrigerator (3000 Btu input). A standard box is used, but storage space has been raised slightly to eliminate excessive stooping when reaching into the lower section of the refrigerator. Freezer compartment is at top. An exclusive feature of the gas refrigerator is the automatic ice-maker which keeps ice-tray full without refilling. Automatic defrosting.

Furnace (80,000 Btu input). Furnace installation is mounted in the top section. An open outlet for the warm air supply is provided on the prototype for display purposes. Installed, warm air outlet would connect to circulating ductwork. The cold air return is at the top of the gas wall, where it enters a filter box designed for optional side entrance of return air. Reversal of the warm and return air ducts may be accomplished if desired. A row of cabinets utilizes space in front of the furnace installation. For climatic regions not requiring furnace heat, the furnace would be optional. Sufficient space would be available for inclusion of a gas air conditioning unit, which would also be optional.

Folding cooking burners. Special folding burners are installed in the wall behind the center counter. They pivot down over the counter to within easy reach in a location that is extremely safe for children and grown-ups alike. An exhaust hood is located directly over the burners, with a twin blower exhaust fan to expel cooking odors from the kitchen automatically. Heated air is expelled to the outdoors through the automatic venting system, making cooking completely cool. Automatic ignition is provided by needle pilots. The gas supply to the main burners is shut off automatically when they are folded into the wall, to provide complete safety. Thermostatic top-burner temperature control is provided on two of the five top burners. When burners are folded into the wall, the counter area occupied becomes additional work space.

Venting. The snorkel-type outside terminal is connected to the gas wall and is designed to protrude through the house wall into the outside atmosphere. All products of combustion, as well as air to support combustion and cool the gas wall, pass through this terminal, thus eliminating the need of a chimney and providing a closed system. Terminal louvers are provided to divert wind and rain from direct contact with the wall openings. A chimney can, of course, be employed if desired.

Controls. Master switches for the electrical system are located in the panel above the refrigerator. Furnace controls are located in the rear wall of the two top left cabinets. Other controls are located conveniently, but out of the reach of small children.

Lighting. Fluorescent lights are located under the soffit cabinets for general illumination, and local lighting at the counter is provided in the exhaust hood.

Plumbing and electrical connections. All the necessary plumbing and electrical connections are ready for operation in the self-contained unit. Only one installation, for the entire *Multimatic Wall* as a unit, need be made.

Access, Removal and Replacement

Access to all appliance components can be made through the front panels. Each component can be removed separately or replaced separately if that should be desired. * * *

You're Money Ahead to

MEASURE PIPE PROTECTION WITH A CALENDAR

How should pipe protection be measured? By first cost? By ease of application? By appearance?

With all the claims made for protective tapes, too often the most important consideration is overlooked—the simple point of how long and how well it will protect the pipe.

Since 1941, when TAPECOAT originated coal tar coating in tape form, this protection has proved to be the best that money can buy for combatting corrosion underground or under water. Lines in service, TAPECOATED as far back as 17 years ago, show no signs of deterioration —a record of uninterrupted performance *no other type of tape can match.* Think what this means in terms of preventive maintenance and elimination of replacement costs!

After all, hot-applied coal tar has proven over the years to be the most dependable and enduring protection. And because TAPECOAT is a hot-applied coal tar coating in tape form, it offers the same lasting protection.

A TAPECOAT sales and service engineer is available at all times to assist you on any corrosion problem and on the various applications of TAPECOAT.

Write for complete details today.

PROVED IN SERVICE

...Underground or Under Water on

Pipe	**Tanks**
Pipe Joints	**Tie Rods**
Service Connections	**Conduit**
Mechanical Couplings	**Cables**
Fittings	**Splices**
Insulated Lines	**Bridge Crossings**

TAPECOAT comes in rolls of 2", 3", 4", 6", 18" and 24" widths—sized to the job. Available also in asphalt. Where primer is desired, specify TC Primecoat, the compatible coal tar primer.

TAPECOAT®

A PROTECTIVE COATING

The **TAPECOAT** *Company*

1533 Lyons Street, Evanston, Illinois

Representatives in Principal Cities

Albuquerque, New Mexico, was the scene recently of colorful fiesta ceremonies marking a "return of the gas light era" as 64 new gas lamps were turned on to illuminate "the Plaza," located in the heart of the city's historic Old Town.

Gas lights, which replace electric facilities on the Plaza and surrounding buildings, were installed by Southern Union Gas Company on standards erected several years ago as memorials to pioneer families of Albuquerque. Mrs. Maria Theresa Urrea Sullivan, descendant of one of the first families to settle in Albuquerque in 1706, lighted the first lamp during opening ceremonies (see photo).

The new lights, which use less than 1000 cu ft of gas per month and burn 24 hours a day, help create the picturesque atmosphere reminiscent of early day Albuquerque. In the near future, many more gas lights will be installed in the area.

1958-59 New England Gas Association Officers. Front row (left to right): Andrew W. Johnston, incoming president; Edgar G. Rhodes, retiring president, and George R. Copeland, first vice president. Back Row (left to right): Gilbert J. Williams, second vice president; Otto Price, treasurer, and Clark Belden, clerk.

Polyken Sales Division of The Kendall Company recently granted a franchise to Cathodic Protection Service of Houston, Texas, to provide increased service for the Southwest area. Cathodic Protection Service maintains branch offices in Tulsa, Oklahoma; New Orleans, Louisiana; Corpus Christi, Texas, and Odessa, Texas.

Utility Employees Form 12 Credit Unions. Twelve new credit unions were formed by employees of utility firms during 1957, bringing the total of such credit unions to 425, the Credit Union National Association reports.

LIBRASCOPE
planimeters
for totalizing miniature strip chart recordings

- *featuring linear and square-root models foot-controlled variable speed drive*

Librascope Planimeters are portable precision analog computers, used for integrating recorded information from charts produced by miniature strip-chart recorders. Recorded information such as flow, pressure, temperature, specific gravity and control characteristics as current, voltage, frequency, etc., may be accurately totaled or averaged, using the Librascope Planimeters.

Featuring high accuracy, variable speed drive and operating simplicity, these units accept chart sizes up to 3 7/16".

Two Models Available: Model 600 for Square Root Integration • Model 601 for Linear Integration.

LIBRASCOPE
GENERAL PRECISION EQUIPMENT CORPORATION GPE

Write for Bulletin M 110-1

LIBRASCOPE, INCORPORATED
40 E. Verdugo Ave. • Burbank, Calif.

7211 Gas Lights Sold in 30 Days

A total of 7211 outdoor gas lights were sold on the Arkansas Louisiana Gas Company system during a 30-day employee sales contest that ended April 24. The contest climaxed a 10-week campaign by the company's sales department during which a total of 12,940 of the decorative outdoor "gaslites" were placed on ALG's three-state distribution system, which serves 232,000 domestic customers in northwestern Louisiana, northeastern Texas, and central Arkansas.

B. E. Harrell, vice president in charge of sales for ALG, said that the contest was between employees in the Arkansas and the Louisiana-Texas operating divisions of the company, and was conducted without any additional expense in company operations.

"We didn't offer any prizes, gave no bonuses, hired no additional salesmen, offered no subsidies, and did no special advertising except in a few cities on the system," Harrell said. At the beginning of the contest we held a meeting of department heads, and asked that they release two regular employees each day on a rotating basis, so that these employees could devote that day to selling gas lights."

An employee in the drafting department sold 86 gas lights during the 30-day contest. A pipeline employee, "who had never sold anything in his life," made 38 sales in two weeks. The one and two sales per day by employees during off-duty hours was the factor that swelled the total.

W. R. Stephens, board chairman and president of Arkansas Louisiana, estimates that use of gas lights sold during the 10 weeks will add approximately 25,000,000 cu ft per month to the company's gas sales, with additional revenues of approximately $13,000 per month.

Considerable publicity was generated by the campaign, and in several cities in the area mayors of local towns proclaimed "Gaslite week" to their citizens. Regular advertising carried pictures and sketches of the "gaslite" models being sold, adaptable either to natural gas or LPG gas. An estimated 1500 employees of the gas company took part in the contest. The winner between the two divisions was determined on the ratio of gas lights sold to the total number of domestic customers served by each division. This gave the following results:

	Customer	Gaslites sold
Arkansas Division	134,528	4,079
Louisiana-Texas Div.	97,345	3,132
Total	231,873	7,211

Gas Refrigerator Manufacturer — Norco, Inc. — has moved its headquarters to a larger building at 5111 West Washington Boulevard in Los Angeles. New location which covers over 20,000 sq ft was necessitated by addition of a line of gas refrigerators and tankless water heaters for general consumer use, to Norco's trailer and marine appliance line. New building includes research, testing, and service school facilities.

New **consulting organization,** the "Unaccounted-For" Survey Engineering Corporation, has been formed to provide consulting engineering services to gas utilities and pipeline companies, with specialization in gas leakage detection and mitigation surveys and "unaccounted-for" problems. President of the Massachusetts concern is Earl R. Hamilton.

Robertshaw-Fulton Controls Company has transferred the heating controls section of its Acro Division at Columbus, Ohio, to its Grayson Controls Division, at Long Beach, California. Grayson will now manufacture the Acro fan and limit controls, thermostats, and gas valves but the precision snap-acting switch line will continue to be produced at the Acro Division.

Carlon Products Corporation of Cleveland has acquired Plastic Industrial Products Company of Somerville, Massachusetts which it will operate under its custom extrusion division headed by James Cleminshaw. John Beaumont, former president of the Somerville company, will remain as general manager of the plant. Plastic Industrial Products Company will be the first flexible plastic pipe manufacturer in New England. In addition to making custom extrusions, flexible vinyl tubing, welting, spline, and window channeling, it will begin production soon on the complete line of Carlon plastic pipe including flexible polyethylene pipe, rigid Kralastic pipe, and PVC pipe.

Gas Appliance Manufacturers Association honored eleven leaders of the gas appliance industry during its recent annual meetings with meritorious service awards. Honored were Chester E. Blome of the Metalbestos Division of William Wallace Company, T. D. Bromley of Dura-Vent Corporation, Keith T. Davis of Carrier Corporation, Julius Klein of Caloric Appliance Corporation, Walter Lee of Majors Controls Company, Norman Millard of Philco Corporation, Frank J. Nunlist of Mueller Climatrol Division of Worthington Corporation, R. B. Robinson of Whirlpool Corporation, Robert I. Warnecke of Roberts-Gordon Appliance Corporation, Harley Weatherly of Chattanooga Royal Company and Don Winegardner of The Majestic Company.

Draketown (Canada) Limited and James Petroleum Equipment Limited, although reported to have joined in forming Draketown James Limited, will continue as independent companies. The combined experience and skills of the two companies will be available in the gas plant engineering and construction field through the new joint organization in Canada.

Napco Industries, Inc., tractor manufacturers, has recognized Ottawa Steel Company, Ottawa, Kansas, as an approved attachment manufacturer. To date Ottawa has designed two attachments specifically for Napco's Crab tractor—a ¾ yd front end loader, and a backhoe, which digs 12½ ft deep.

Cleveland Trencher has appointed A. T. Green Machinery Company distributor for the complete line of Cleveland trenchers, sidecranes, backfillers, and tampers. The Pittsburgh-based organization will handle sales, parts and service in the western Pennsylvania area.

The SCF

Fence Rider

Let SCF consultants "Ride Herd" on your gas leaks—account for "unaccounted-for" and eliminate safety hazards.

We can supply "Extra hands" and equipment to repair leaks if you need the help.

SOUTHERN CROSS FORESTERS
3677 Buford Highway MElrose 4-4227
Atlanta 6, Ga.

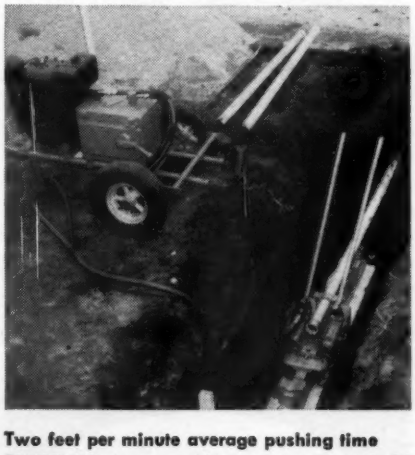
"Please tell him the truth about Gas. He's been brain-washed by the electric people!"

FAST, LOW-COST WAY TO INSTALL PIPE . . .

push it under streets, roads, tracks, lawns with a timesaving

GREENLEE HYDRAULIC PUSHER

Speed underground piping jobs this way. GREENLEE Pusher is one-man-operated (by hand or with power pump), portable, simple to set up and use. No tearing up of pavement, floors, lawns . . . does away with extensive ditching, tunneling, backfilling, repaving. GREENLEE Pusher cuts job time to a fraction . . . often pays for itself on first job.



Two feet per minute average pushing time

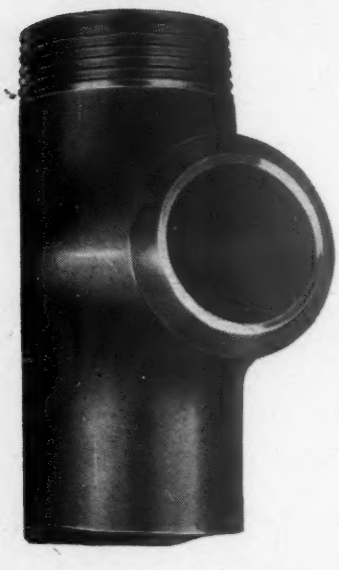
GREENLEE Pushers are available in two sizes: No. 790 for ¾" to 4" pipe . . . No. 795 for pipe over 4", concrete sewer pipe, large ducts. Average performance of No. 790, shown above with power pump, two feet per minute. Write for literature.

GREENLEE

GREENLEE TOOL CO.
2426 Columbia Avenue • Rockford, Illinois

New
TAPPING TEE
FOR GAS MAINS
by Nibco

PART NO. 4911 - GS
Made from Schedule 40 ASTM A-106 A or B carbon steel



- **WELDS TO MAIN AND 1-1/4" SUPPLY LINE**
- **COLD-FORMED FROM SEAMLESS STEEL TUBE**
- **EXTRA STRONG, EXTRA SMOOTH INSIDE AND OUT**
- **COMPLETE WITH PLUG AND CAP**

NIBCO

since 1937 manufacturers of wrot copper, carbon and alloy steel fittings

for complete information write NIBCO INC.
DEPT. H-8006 Elkhart, Indiana

Men At Work

IN THE GAS DISTRIBUTION INDUSTRY

R. T. Klemme

J. O. Grantham

● Northern Natural Gas Company has announced two personnel changes. **Randall T. Klemme** has joined the company as director of economic research and area development. He will direct Northern's program for industrial and community development in its market area and coordinate this program with those of local, state, and regional development agencies. **J. O. Grantham** has joined Northern Natural as director of personnel, a newly created position. He was formerly employed by Anderson Prichard Oil Corporation in Oklahoma City.

● **Norman E. Kenyon** has been appointed administrative assistant to the president of Michigan Consolidated Gas Company. He was formerly public relations director of the Fred M. Randall Agency.

● Iroquois Gas Corporation has announced the following changes in its executive and management staffs: **Gerald J. Greenan** has been elected to fill the vacancy on the board of directors created by the resignation of **John J. Muckler,** who retired from active service as secretary and treasurer May 1. **Louis R. Reif,** formerly head of the title and claim department has been elected vice president of the company. **Ralph E. Grimm,** superintendent of distribution, has been promoted to general superintendent. **Lloyd E. Hahn,** assistant superintendent, has been promoted to superintendent filling the position vacated by Grimm.

● **Burt Larson** has been appointed general sales manager of Southern Counties Gas Company. He has served as manager of residential sales since 1951 and will retain the residential sales duties as part of his new post.

Burt Larson

Charles Kuhn

● **Charles Kuhn,** formerly vice president in charge of sales for Hills-McCanna, Chicago, has been appointed sales manager, regular products, of Dresser Manufacturing Division, One of the Dresser Industries, Inc. Kuhn assumes the position vacated by **H. Z. Hight** who is now president of Bonded Products, Inc.

● **Everett A. Taylor,** formerly general sales manager, has been elected vice president and general manager of Providence Gas Company. **Francis J. McLaughlin, Jr.,** formerly residential sales manager, has been appointed assistant general sales manager and residential sales manager.

● **George W. Peck,** superintendent of gas operations for Central Vermont Public Service Corporation, has been elected a director of the New England Gas Association.

D. T. Gilbert

J. P. Crowley

● **David T. Gilbert** has been elected president of Greenwich Gas Company succeeding retiring **Gardner L. Bristol. John P. Crowley** has been re-elected vice president and **Richard A. Winslow** has been elected treasurer, at the annual meeting of the board of directors.

1897 1958

GOODMAN
USED SINCE 1897
2" HANDLE & LOCKING SLEEVE
GAS MAIN STOPPER

PIPE STOPPERS OF ALL KINDS

•

SAFETY GAS MAIN STOPPER CO. INC.

523 Atlantic Avenue
Brooklyn 17, N. Y.
Cable Address: GASTOPPER, N. Y.

Errata

In the article *"Substitutability of Propane-Enriched Carrier Gases for Natural Gas,"* by R. T. Ellington, E. F. Searight, and H. R. Linden, which appears on pages 35, 36, 37, 38, 40, and 42 of this issue, the following corrections should be noted.

Page 38, lefthand column, under subhead **Test Gases,** *first paragraph, lines 5 thru 8 should read* "percent relative heat input (heat input factor — equal to heating value divided by square root of specific gravity — is the same for substitute and base gas).

Page 38, middle column, first paragraph, line 7, should read "containing CO, N_2, air or CO_2, both at"

Page 38, righthand column, second paragraph, line 2, should read "content of the reformed product gas to CO_2"

Page 40, lefthand column, fourth paragraph, line 9, should read "loading (58,000 Btu per hr per sq in.)"

Page 40, middle column, second paragraph, line 4, should read "The two top range burners"

Page 40, middle column, third paragraph, line 6, should read "that the port size for the manufactured"

Page 42, righthand column, first paragraph, beginning with line 7, the second paragraph, line 6, should read as follows —

As a result, the limiting factor at the soft adjustments for the 1008 Btu per std cu ft propane-air mixture was transient flashback; this did not disturb the general trend of decreasing substitutabilities with increases in heating value and relative heat input. The limiting factor at the hard adjustments for the 1528 Btu per std cu ft propane-air mixture was yellow-tipping. Thus, for propane-air, the limiting factor at all three base gas adjustments was flashback at the 1000 Btu per std cu ft heating value level, and yellow-tipping at the 100 percent relative heat input level.

Page 42, lefthand column, third paragraph, line 5, should read "these mixtures was very similar to that"

Page 42, under "References," item 9, first line, author Linden was incorrectly spelled as Lindon.

The editors regret that these errors occurred in this article and extend apologies to the authors.

No Service Calls for One of These Vents!

Only when a utility service-man sees the red-and-black Metalbestos "Safety System" Seal can he be sure that vent failure isn't responsible for the consumer's service call. Then he knows that trouble lies below the draft hood . . . because the Safety Seal tells him an all-Metalbestos vent has been designed and installed according to the Metalbestos "Safety System" Gas Vent Tables.

The vent system behind the Metalbestos "Safety Seal" eliminates venting service calls . . . promotes the consumer's total enjoyment of gas heat.

Look for the Metalbestos "Safety Seal" and encourage its use. It's good for your business . . . good for gas.

For complete information on the new Metalbestos "Safety System" write Dept. AA-4.

Stocked by principal distributors in major cities. Factory warehouses in Akron, Atlanta, Dallas, Des Moines, Chicago, New Orleans, Los Angeles, Woodbridge, N.J.

METALBESTOS DIVISION
WILLIAM WALLACE COMPANY · BELMONT, CALIF.

Bulletin Board

NEW BOOKS...BROCHURES...CATALOGS

For more information on items described here in brief, use the handy reply card and circle the corresponding numbers

Industrial Television Equipment. New 8-page illustrated brochure, "How Many Jobs," shows complete line of industrial television equipment now available for business and industry. Different types of cameras, control units, monitors, accessories, and projection systems are described. Also varied applications, including installations with unusual engineering requirements, are pictured and detailed. *General Precision Laboratory.*

CIRCLE (73) ON THE REPLY CARD

Mobile Radio Systems. Two new 4-page bulletins describing Du Mont's four vehicular communications facilities in the 25-54 MC band, are now available. Each two color bulletin pictures models and components, and lists features and operating specifications. Models MCA-110-B and MCA-120-B are designed to provide highly reliable communications in the 25-54 MC band, and the models MCA-105-B and MCA-115-B mobile radio systems are designed to provide high power vehicular communication facilities in the same 25-54 MC band. These two systems provide clear reception at maximum working distances and include transmitter, receiver, power supply assembly, control head and microphone, speaker, antenna, power fuse assembly, and all necessary cables. *Mobile Communications Department, Allen B. Du Mont Laboratories, Inc.*

CIRCLE (74) ON THE REPLY CARD

Heat Treating Furnaces. New product bulletin just issued by Charles A. Hones, Inc., shows representative items of complete "Buzzer" line of gas-fired heat treating and melting furnaces and burners. Fundamental descriptive matter, tables, and Btu ratings are given. *Charles A. Hones, Inc.*

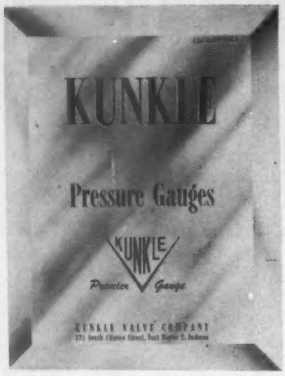
CIRCLE (75) ON THE REPLY CARD

Automatic Odorant Metering. New engineering data sheet, "Automatic Odorant Feed Systems," illustrates and describes four modern, automatic methods to meter and feed a precise ratio of odorant to natural gas lines. The 2-page data sheet explains how controlled volume diaphragm pumps feed mercaptans or other odorants automatically and in accordance with varying main line flow rates — without leakage. All-pneumatic system using aiROY metric (air-driven) controlled volume pumps is also described in detail. Specifications, recommendations, flow diagrams, and lists of equipment used in each system are included. *Milton Roy Company.*

CIRCLE (76) ON THE REPLY CARD

Steel Valve. New full color four-page brochure explains principle of operation of Kerotest's latest steel valve, the "Keroseal." This valve is a new full opening, double block and bleed, non-lubricated, optional flow valve that offers a vapor-tight seal. It is designed to handle vapor and liquid petroleum products and petrochemical fluids. Various applications and featured advantages are covered by the brochure. Materials and specifications, illustrations, and schematic drawings are also included. *Kerotest Manufacturing Company.*

CIRCLE (77) ON THE REPLY CARD



Gage Catalog. New 48-page catalog illustrates Kunkle's new line of high-reliability gages with ranges from 15 psi or 30-in. of vacuum, to 20,000 psi plus complete engineering and selection tables for applications in processing plant and power instrumentation. Gages for air, gas, vapors, and liquids utilize Bourdon tubes of bronze, drawn or bored stainless steel and other alloys with movements and cases to meet all requirements. *Kunkle Valve Company.*

CIRCLE (78) ON THE REPLY CARD

House Heating Folder. Folder on gas house heating for hand out or direct mail is being made available to utilities again in 1958 through AGA auspices. Folder can be mailed to prospective heating customers, used as a selling piece at shows, model home openings, on display floors and salesmen's home calls, and in bulk distribution to heating contractors for use with their customers. No brands are mentioned and folder tells strong gas heat story. Company name can be imprinted at no extra cost. *The Randall Company.*

CIRCLE (79) ON THE REPLY CARD

Masonry Drill. New masonry drill features fast spiral flutes that lead dust from both cutting edges of the carbide tip. By removing all dust quickly when drilling concrete, brick, stone, tile, marble, and other similar building materials, dust packing and stalling are eliminated. Drill is made of alloy steel and tipped with Carboloy Carbide. Sizes range from 11/64 to 1½-in. *Holub Industries, Inc.*

CIRCLE (80) ON THE REPLY CARD

Photodrawings. New Eastman Kodak publication describes modern technique of using photographs to convey engineering drawing information. The 12-page illustrated booklet is divided into sections on making the picture negative, equipment and materials needed, making the master photodrawing, direct process reproduction, halftone methods, continuous tone methods, composite methods, blueprint reproduction, and lithographic reproduction. Simply the technique is that photographs are reproduced on a translucent material on which engineering detail and superimposed sketches can be added. From this master photodrawing, work prints can be made by the conventional processes. *Eastman Kodak Company.*

CIRCLE (81) ON THE REPLY CARD

Continuous Level Indicator. New 4-page two color brochure describes Robertshaw-Fulton's new electronic measuring unit, the Telestor. Unit is housed in a dust tight case and may be installed adjacent to the tank, bin, or other vessel containing material to be measured. Specifications, models, and typical installation diagrams are included in bulletin. Unit operates on basic principle of a capacitance bridge; accurately measures liquids, viscous fluids, powders and granular solids regardless of whether they are conducting or non conducting; measures total mass or level of product in vessel, and operates under pressure or vacuum or at elevated temperatures. *Aeronautical and Instrument Division, Robertshaw-Fulton Control Company.*

CIRCLE (82) ON THE REPLY CARD

Proportioning Pump. New eight-page, two-color bulletin describing the new integral McCannameter has just been released by Hills-McCanna Company. Bulletin details features of new pump design that affords space savings of up to ⅔ over previous designs. McCannameter is available in either diaphragm or bellows construction with maximum capacities from 6 cc/min to 6 g.p.h. Maximum discharge pressure is 2500 psi. Dimensional specifications are also shown. *Hills-McCanna Company.*

CIRCLE (83) ON THE REPLY CARD

Automatic Valves. New 4-page bulletin features quick-reference data on Cash-Acme's more popular pressure reducing and regulating valves, back pressure valves, and diaphragm operated control valves. Folder includes resume of seven different valves, their available pressures, body materials, service, and pipe sizes. *A. W. Cash Valve Mfg. Corporation.*

CIRCLE (84) ON THE REPLY CARD

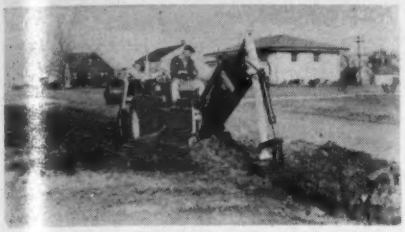
Color Code Kit. Materials and information necessary to design a successful color coding system are included in new color code kit produced by Crown Industrial Products Company. Key item in the kit is a color code chart in which spaces are provided to letter in names of items being identified, along with spaces for the identifying color code. System is based on use of aerosol spray cans as a fast economical way of applying color to material being coded. Seventeen "Crown" colors available give a possible 153 distinct and separate color combinations in a combined one and two-color code system. *Crown Industrial Products Company.*

CIRCLE (85) ON THE REPLY CARD

New Equipment

FOR THE GAS DISTRIBUTION INDUSTRY

For more information on items described here in brief, use the handy reply card and circle the corresponding numbers

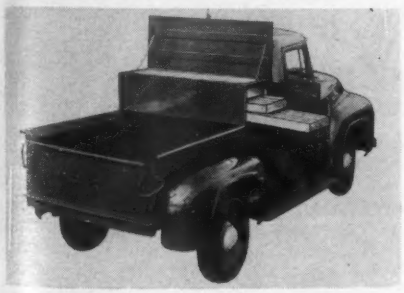


Construction Equipment. International Pippin 350 backhoe and No. 325 front end loader have been announced as a part of the new line of International Pippin and International Wagner heavy-duty backhoes and loaders now being sold by International Harvester Company. Under a recent agreement, International Harvester purchases Wagner and Pippin products made specifically for International tractors, for resale through its dealers and company owned retail stores, warranted and serviced by IH on the same basis as International tractors and McCormick equipment. Wagner loaders are available in six sizes for the six models of International industrial wheel tractors ranging from 12.8 to 68 engine hp. Two models of International Wagner backhoes are supplied for the larger 40, 50.2, 60, and 68 hp tractors. International Pippin loaders and backhoes come in three sizes each for International 330 and 350 Utility tractors. In all nine loaders and five backhoes are available. *International Harvester Company.*

CIRCLE (15) ON THE REPLY CARD

Pipe Thread Compound. Pipetite-Stik, pipe thread compound in stick form, is now available in a new 3-doz self-display counter carton. This pipe joint compound can be used for all pipe installation and maintenance. Recent improvements in formulation makes it suitable for pressures up to 10,000 psi, temperatures to 750 F. Compound doesn't dry out; may be used on all metal or ceramic threads; and is particularly effective on plastic threads. *The Lake Chemical Company.*

CIRCLE (16) ON THE REPLY CARD



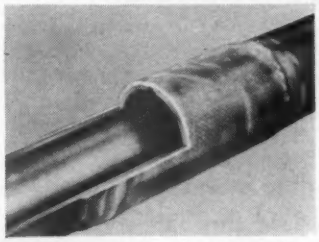
Truck Storage Compartment. New all purpose storage compartment, Utility Body Company's U-56 cross compartment, is readily mounted on any truck. Compartment is engineered to provide variety of storage space from small part bins to large bulk material storage areas. Can be installed across front of any pickup bed or on any flat bed truck. Unit is fabricated of cold rolled steel and electrically welded into a single compartment with hemmed edges on all parts. Side door is provided with keyed lock and top lid has provision for padlock. *Utility Body Company.*

CIRCLE (17) ON THE REPLY CARD

100-watt Transistor-Powered Mobile Radio. General Electric has announced a new thermostatically protected transistor-powered 100-watt mobile radio, first of its kind. New equipment is designed with automatic cut-off and re-set functions which keep the transistor power supply safe against abuse due to heat caused by overload, duty cycle and environmental conditions. Latest developments in transistor technology have made it possible for GE to extend its line of transistor-powered equipment into the higher power ranges at this time. Highest power previously available in the transistor-powered category was 60-watts with GE as the industry's sole manufacturer of units in this wattage. All G-E Progress Line mobile equipment currently offered for sale can be supplied with transistor power. New 100-watt unit is equipped with die-cast heat sink of special design. Made of brushed aluminum, the sink resembles a waffle grid and serves as a total enclosure for power transistors. Equipment provides maximum dissipation of heat from transistors and minimum heat absorption. *General Electric Company.*

CIRCLE (18) ON THE REPLY CARD

Epoxy-Based Sealer. Emergency repairs of metals, plastics, wood, concrete, and other materials can be made with Homalite 345, an epoxy-based compound re-

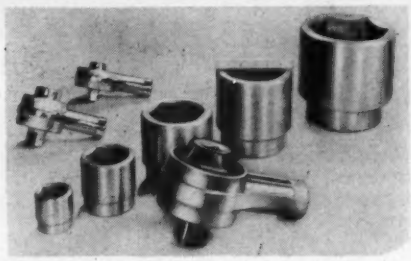


cently developed by the Homalite Corporation. Repaired equipment can be back in service within an hour and the repairs are permanent. Sealer provides new method of repairing leaking pipes, broken castings, or plastics, and corroded sheet metal. *The Homalite Corporation.*

CIRCLE (19) ON THE REPLY CARD

3-Way, 3-Position Electric Motor Operated Valve. Addition of 3-position control to the already established 3-way hydramotor valve for automatic tank switching control has been announced by General Controls. For the first time, General Controls provides switching for periodic sampling through one simple system, using an all-electric control. This permits the 3-way valve to operate directly from an electric timer, diverting flow from one line to another or to shut down completely — according to an automatic programmed schedule or through overriding electrical switches located remotely from tank batteries. Valve is available in 115 or 230 v; in sizes up to 3-in. ips, 250 psi cast iron or 600 psi full or reduced port, and up to 2-in. ips with ¼-in. port 1500 psi. Unit is completely self-contained, with no separate actuating cylinders or outside pneumatic power required. Available with Hammel-Dahl pneumatic actuators for gas or air operated systems. *General Controls.*

CIRCLE (20) ON THE REPLY CARD

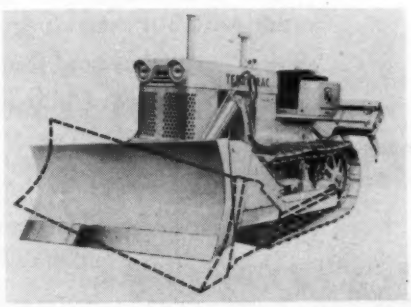


Industrial Tools. The X-4 Corporation has announced addition of a large wrench to their line of geared head wrenches and also a new line of large socket wrenches. Tools now available include three models of the X-4 geared head wrench, also known as torque multipliers. New model TD-1500 is rated at 4000 ft lb, with a 1-in. input drive and a 1½-in. output drive; has all the features previously announced in the smaller models TD-750 and TD-1000. *X-4 Corporation.*

CIRCLE (21) ON THE REPLY CARD

Portable Oxygen Indicator. An M-S-A Portable Oxygen Indicator for checking oxygen deficiency or conditions in an atmosphere that might increase fire and explosion hazards has been developed by Mine Safety Appliances Company. Instrument measures percent of oxygen throughout a range of 0 to 25 percent oxygen content by volume with an accuracy of plus or minus ½ percent. Meter scale follows a square root function and has the five percent graduation near the center. Entire instrument occupies only 160 cu ft and weighs less than 6 lb complete with sampling line. Leather waist and neck straps are provided with the instrument. Sampling lines and probes of different length and type are available. *Mine Safety Appliances Company.*

CIRCLE (22) ON THE REPLY CARD

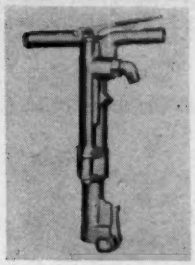


Power Tilt Dozers on Small Crawlers. Hydraulic "Tilt-crown" dozers, first introduced on 80 and 100 hp TerraTrac industrial crawler tractors last year, are now available on 42 to 62 hp TerraTrac models. Especially designed for road crowning, ditching, digging out trees and brush, and maintaining level grades in rough terrain, the new blades can be tilted to either side while the tractor is in motion. Large hydraulic cylinder mounted on left push arm and attached to upper rear corner of blade furnishes the power. Telescoping steel cover protects cylinder from brush, rocks, etc. and special swivel bracket permits blade to tilt without twisting strains on the two hydraulic lift cylinders. *J. I. Case Company.*

CIRCLE (23) ON THE REPLY CARD

New Equipment

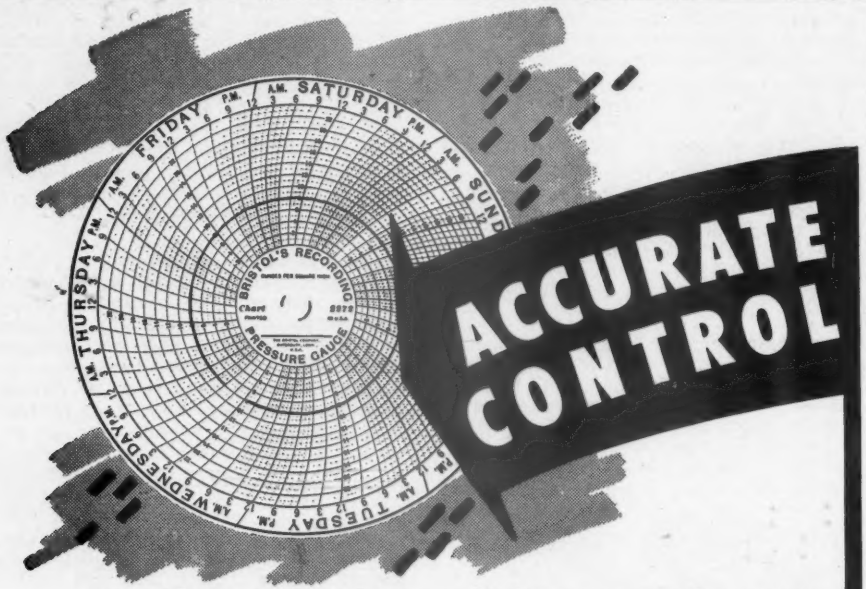
Lightweight Breaker. New lightweight breaker featuring a latch type steel retainer and a simplified swivel "O" ring air connection is now available. Unit is designed for durability and low maintenance as a 35 lb class breaker. Unit is also available with a clay spade handle, or a trench digger handle. Is especially suited for light demolition work, horizontal breaking, digging trenches, breaking frozen ground, or trimming. *Le Roi Division, Westinghouse Air Brake Company.*



CIRCLE (24) ON THE REPLY CARD

New Valve Line. New 2-way solenoid valve that combines large orifice capacity with high pressure differential has been announced by Skinner Electric Valve Division. Normally open or normally closed valve is now available with ¼-in. orifice and ¼-in. NPT and a capacity to handle pressure from 5 to 200 psi. The R series, pilot-operated piston valves use the V5 as an operator. These valves are designed for use with all common media such as air, water, oil, and semi-corrosive media. An explosion-proof design is also available. The R series valve weighs only 1¼-lb and mounts directly to the line by means of the ¼-in. NPT. Will handle temperatures of minus 65 to 180 F ambient and minus 56 to 150 F media. *Skinner Electric Valve Division.*

CIRCLE (25) ON THE REPLY CARD



Reynolds Service Regulators are built to meet specific requirements—years of operation in the field through a complete range of operating conditions have proved not only their superiority but their durability. With parts so precisely machined for each model that they are completely interchangeable. The accuracy you require in performance is assured.

MODEL 10

Dead Weight or Spring Type, with or without Mercury Seal, or Dead Weight Safety Seal or diaphragm operated relief valve. All working parts are so accessible as to be interchangeable without removal from pipe line.

MODEL 20

Dead Weight or Spring Type, with or without Mercury Seal, or Dead Weight Safety Seal or diaphragm operated relief valve. All working parts are so accurate as to permit complete interchangeability in shop.

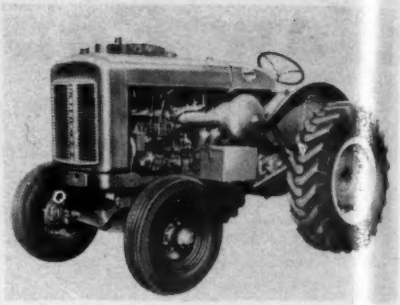
MODEL 30

For horizontal or vertical connections, with or without removable valve pocket. Available with either Spring or Dead Weight adjustment. With or without Mercury or Dead Weight Safety Seal or diaphragm operated relief valve.

Reynolds Gas Regulator Co.

ANDERSON, INDIANA, U. S. A.

GAS CONTROL SINCE 1892

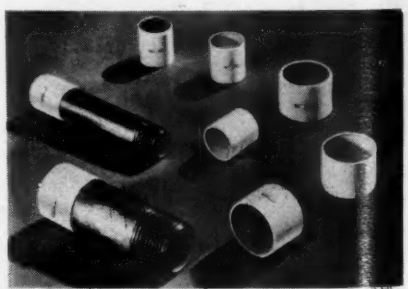


Diesel-Powered Air Compressors. Schramm has announced a full diesel powered 125 Pneumatractor unit. New features include a fuel pump of the distributor type, and use of a 12 v starting equipment that uses the principle of starting on gasoline, preheating the entire engine, and then switching to full diesel. Use of diesel fuel provides economy of operation, gives lower cost per gal, as well as more power per gal, and permits use of same fuel as other equipment on the job. *Schramm, Inc.*

CIRCLE (26) ON THE REPLY CARD

Wrench. Clik-Stop, a new automatic wrench with the "golden" knurl, has recently been announced by Proto Tool Company. New wrench is the first automatic "adjustable" ... requires no adjustment other than simply turning the knurl as in the case of an ordinary adjustable wrench. As knurl is turned, jaw openings are held fast, can't change position. Wrench is available in five sizes — 4, 6, 8, 10, and 12-in. Tool is forged from fine alloy steel, highly polished, and chrome plated to prevent rust and enhance appearance. *Proto Tool Company.*

CIRCLE (27) ON THE REPLY CARD



Snap-On Thread Protector Caps. New thread protector caps that snap on instantly, but will not come off unless unscrewed, are now available. A metal staple (patent pending) snaps into and conforms to the thread pattern, holding the cap firmly regardless of vibration and jarring during shipment, handling, installation, or actual plant use, and during storage. Caps are made from plastic coated kraft paper and produced on high production machinery. Kraft paper affords ample structural strength for practically all applications and conforms closely to the surface for a snug fit to keep out dust, dirt, etc. Plastic coating insures protection against moisture, grease, etc. Known as Tecto-Caps, protectors are available in standard diameters to fit all pipe and tod sizes up to one inch. Can be supplied in closed or open end types. *Precision Paper Tube Company.*

CIRCLE (28) ON THE REPLY CARD

PROFESSIONAL DIRECTORY

Design EGE Construction

LP-GAS PEAK SHAVING & STANDBY PLANTS for MUNICIPALITIES & INDUSTRY

EMPIRE GAS ENGINEERING COMPANY

7 Baltimore Place NW • TR 2-6611 • Atlanta 8, Ga.

DRAKETOWN 2000®

★ *Standby*

★ *Augmentation*

★ *100% Town Supply*

PROPANE PLANTS *Design · Engineering · Construction*

DRAKE & TOWNSEND INCORPORATED 11 WEST 42ND STREET NEW YORK 36, N. Y.

Engineers, Designers and Manufacturers of

LP-GAS STAND-BY PLANTS

and special equipment for every requirement

BUTANE-ALGAS-PROPANE

TELEPHONE TRINITY 0845

AMERICAN LIQUID GAS CORPORATION

1109 Santa Fe Avenue • Los Angeles 21, California

BLACK & VEATCH
CONSULTING ENGINEERS

Natural Gas, Electricity, and Water Utilities
Production, Transmission, Distribution
Reports, Design, Supervision of Construction
Investigations, Valuation, and Rates
1500 Meadow Lake Parkway, Kansas City 14, Missouri (Since 1915)

THE *FINEST* FOR MODERN GAS DISTRIBUTION SERVICE

NORMAC

Insulating **Fittings**

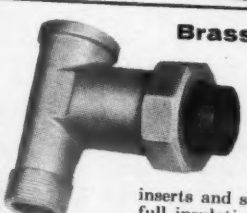
Malleable Service Ell

The insulating principle depicted above is carried out in all Normac Ells and Tees.

Malleable Couplings

Normac Insulating Malleable Couplings and fittings are available with polyethylene inserts and semi-insulating gaskets or full insulating rubber gaskets.

Brass Fittings



Normac insulating Brass compression end Tees, Ells and all compression end fittings are available with polyethylene inserts and semi-insulating or full insulating rubber gaskets in ¾", 1" and 1¼" iron pipe sizes.

New CATALOG Write for your copy . . . it gives complete details and specifications of NORMAC equipment.

NORTON-McMURRAY Manufacturing Co.

919 North Michigan Avenue

Couplings • Meter Bars • Sleeves • Cocks
Bell Joint Clamps • Service Tees and Ells

---

3 WAYS BETTER

AMERICAN® INSULATED METER CONNECTIONS

1 **Permanent, molded-on design**—insulation covers pilot flange . . . extends up the body — no loose parts — simplifies assembly and minimizes possibility of short circuit due to moisture.

2 **Tough, Nylon insulation** — high mechanical strength prevents crushing — seals tight — high dielectric strength eliminates electrolysis.

3 **Interchangeability** — insulated meter connections are interchangeable with standard connections — will accept standard caps and washers reducing inventory problems.

Ask your nearest American representative for Bulletin 308 describing all insulated and standard meter connections.

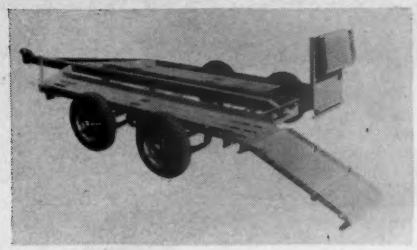
AMERICAN® METER COMPANY

INCORPORATED ESTABLISHED 1836

AMERICAN METER CO EST 1836

GENERAL SALES OFFICE: Somerton, Philadelphia 16, Penna. • Albany • Alhambra • Atlanta • Baltimore • Birmingham • Boston • Chicago • Dallas • Denver • Erie • Houston • Kansas City • Los Angeles • Minneapolis • New York • Omaha • Pittsburgh • San Francisco • Seattle • Tulsa • Wynnewood. IN CANADA: Canadian Meter Company, Ltd., Milton, Ontario • Calgary • Edmonton • Regina

SUPPLIERS TO THE GAS INDUSTRY for Ironcase, Tinned Steelcase, Aluminumcase and Welded Steelcase Meters • American-Westcott Orifice Meters Instruments • Reliance Regulators • Apparatus • Valves

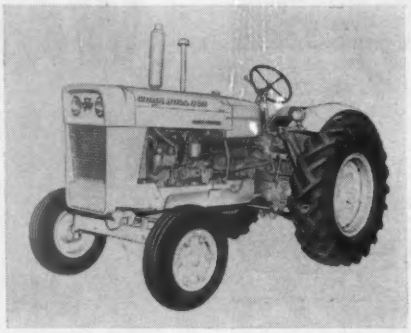


Tractor Transport. Tractor, backhoe, front-end loader, fork lift, or other light industrial equipment can be hauled to the job site with a light pickup truck by utilizing new Haulette tractor-transport. Steel ramps lower so equipment can be rolled onto the transport. Easy-glide design and true-camber performance assure easier towing and greater safety by eliminating sidesway. Heavy gage welded construction with Fayette undercarriage features, assures proper weight distribution and low center of gravity. Lengths range from 14 to 20 ft overall, with bed lengths of 11 to 15 ft. Loading widths are from 70 to 95 inches. Larger models have four wheels with 8 by 14.5 12-ply tires and electric brakes. Ball hitch or lunette eye less pintle are optional for attaching Haulette to truck. *Haulette Division, Fayette Manufacturing Company.*

CIRCLE (29) ON THE REPLY CARD

Electronic Line Locator. Wilkinson Products has announced a new advanced design in electronic line locators. The Wilkinson Line Locator, model W-2, is used for determining the location and depth of all subsurface installations, pipes, cables, valves, boxes, and distribution lines. Miniaturization has been achieved by use of transistors, sub-miniature components and etched circuitry. New model locator is housed in a molded glass fibre case that provides protection for heavy field use. Dimensions are one-fourth that of conventional pipe locators; overall weight (assembled) has been reduced to 4 lb. Transistors, as well as resistors, capacitors, etc., are soldered into the circuits. Transistors have a rated life of 70,000 use hours; small mercury cells and miniature high current battery are leak proof and will last 10 times longer than those used in old type locators. Telescopic connecting handle of anodized aluminum and a transistorized plastic ear set complete set. *Wilkinson Products Company.*

CIRCLE (30) ON THE REPLY CARD



Medium Weight Tractor. New Work Bull 303 Industrial Tractor, now available from Massey-Ferguson Industrial Division, features hydraulically-actuated reversing clutches — controlled by a combination accelerator and directional pedal that permits instantaneous directional change without shifting. Power diversion of the 52 hp 208 cu in. displacement engine is provided by a torque converter. Other unit features include power steering and double disc brakes with equal braking power in either forward or reverse. Work Bull 500 loader fits directly to the tractor and the pump drive and mounting are already built in the tractor. Standard Davis backhoe also attaches to the Work Bull 303 and 500 loader combination. *Massey-Ferguson Industrial Division.*

CIRCLE (31) ON THE REPLY CARD

Engineers Transits. Atlas Instrument Company has announced three models of high precision imported engineer transits. The 30 power models are hand finished and assembled for high accuracy, have precision calibrations for most exact readings and are equipped with long level-bubble on telescope and two horizontal bubbles. Telescope contains cross and stadia lines on reticle. Minimum focus is 6½ ft. The deluxe model No. T-26 has a minimum focus of 6½ ft, with a magnification of 26 x. Telescope contains one vertical and three horizontal crosshairs. The 18 power model, the T-18, is also available; has a minimum focus of 3 ft; and similar to the T-26, telescope contains one verticle and three horizontal crosshairs. Accessories available with all models include: Plumbbob, sunshade, adjusting pins, magnifier, screw driver, wooden carrying case, and tripod. *Atlas Instrument Company.*

CIRCLE (32) ON THE REPLY CARD

CLASSIFIED

FOR SALE

USED BUTANE — AIR PLANT

In good operating condition.

15,000 cu. ft. per hour capacity, complete with all mixing and vaporizing equipment controls and safety devices. Includes 1-18,000 gallon mixing tank; 1-14,000 gallon liquid storage tank; 1-8,000 gallon surge tank.

Must be removed from premises as soon as possible.

Address all inquiries to:

H. J. BELL, Gen. Supt. of Gas Operations
Southern Indiana Gas and Electric Company
Hulman Building, Evansville, Indiana

SALES MANAGER

Competent individual to manage builders division of large S.E. Pennsylvania utility. Experience must include knowledge of characteristics of domestic appliances, ability to formulate promotional programs and sales presentations. Reply giving all pertinent data to:

Z-55, P. O. BOX 2068
Philadelphia 3, Pa.

ADVERTISERS INDEX

American Liquid Gas Company . . . . —
American Meter Company 44, 63
American Meter Company, Reliance Regulator Division 6
Aqua Survey & Instrument Company . . . . . —
Arkla Air Conditioning Corporation . . . . . Inside Front Cover
Barber-Greene Company . . . . . —
Blaw-Knox Company, Buflovak Div. . . 53
Chaplin-Fulton Manufacturing Company 9
Cleveland Trencher Company, The . . 50
M. J. Crose 48
Deere & Company . . . . . —
Drake & Townsend, Inc. 63
Dresser Industries, Inc. 39
Dresser Manufacturing Division . . . . . —
Empire Gas Engineering Company . . . —
Fisher Governor Company . . . . . —
Greenlee Tool Company 57
H & M Pipe Beveling Machine Company . . . . . —
Hays Manufacturing Company . . . . . —
Johns-Manville . . . . . Inside Back Cover
Joslyn Manufacturing & Supply Co. . . —
Lancaster Meter Parts Co. . . . . —
Librascope, Incorporated 56
Lone Star Steel Company 10
Massey-Ferguson Industrial Division, M-H-F, Inc. . . . . —
Midwestern Pipeline Products . . . . . —
Moonglow Gas Light Co. . . . . —
Mueller Co. 4, 5
Nibco, Inc. 58
Norton-McMurray Manufacturing Company 63
Norwalk Valves . . . . . —
Oronite Chemical Company 8
Pittsburgh Coke & Chemical Company, Protective Coatings Division 11
Reynolds Gas Regulator Company . . . 62
Robertshaw-Fulton Controls Co. 12
Rockwell Manufacturing Company, Products Division . . . . . Front Cover
Rockwell Manufacturing Company, Nordstrom Valve Division 2
Safety Gas Main Stopper Co., Inc. . . 58
Sheehan Pipeline Construction Co. . . —
Sherman Products, Inc. 49
Skinner, M. B., Company 46, 47
Somerville Construction Company . . . —
Southern Cross Foresters 57
Southwestern Industrial Electronics . —
Sprague Meter Company, The . . . . . Back Cover
Standard Pipe Protection, Inc. 51
Superior Meter Company 41
Tapecoat Company 55
United Engineers & Constructors, Inc —
Universal Controls Corp. . . . . —
Vermeer Manufacturing Co. . . . . —
Wilkinson Products Company . . . . . —
William Wallace Company 59

THIS INDEX IS PROVIDED AS AN ADDITIONAL SERVICE FOR OUR READERS — THE PUBLISHER ASSUMES NO RESPONSIBILITY FOR ERRORS OR OMISSIONS